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ABSTRACT

Developed as part of UNESCO's program in the teaching of science and technology, this bibliographic guide is intended to assist those concerned with curriculum development by providing annotated references to materials aimed at making science and technology more socially relevant. Materials are included which would help pupils, teachers, and teachers of teachers to think about the social relations of science and technology in developing countries. The references are organized into five major sections. These include: (1) "The Social and Economic Role of Scientific and Technological Knowledge and Personnel"; (2) "Science and Technology Education"; (3) "Science and Technology in Developing Countries"; (4) "Consequences of the Application of Science Based Technological Innovations"; and (5) "Science and Technology and the Satisfaction of Basic Needs and Social Goals." Each of the major sections and sub-sections contains an introduction which reviews the addressed topics. An appendix is also included which provides the names and addresses of international agencies and publishers. (ML)

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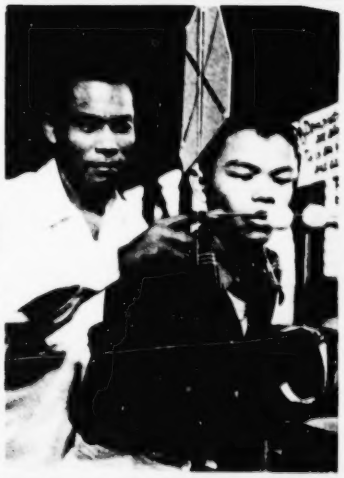

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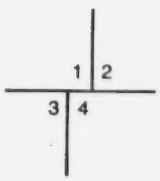

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Science and Technology Education

Document Series No. 18

The Social Relevance of Science and Technology Education

An Annotated Bibliographic Guide
prepared by
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of the University of Sussex

**Division of Science
Technical and Environmental
Education**

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PREFACE

This bibliographic guide has been prepared as part of Unesco's programme in the teaching of science and technology. Throughout the world there is a growing awareness of the need to devise science and technology curricula which are relevant to national and social needs. Several recent international conferences have underlined this theme, and projects to develop appropriate teaching materials have been established in many countries. This guide is intended to assist those concerned with curriculum development inthis field by providing annotated references to material available in the English language. It may also be helpful to teachers and to others working in the field of education who are concerned to make their activities in science and technology education more socially-relevant.

The selection of material and the opinions expressed are those of the authors; they are not necessarily those of Unesco.

INTRODUCTION

Interest in the social relations of science and technology has been growing at an accelerating pace both in the Industrialised Countries since the 1930's and in the Developing Countries since the 1960's. This interest has been matched by a corresponding appreciation of the importance of introducing these factors into science and technology education. A bibliography such as this has been thought necessary, or at least desirable, to give teachers in this field in Developing Countries more ready access to suitable teaching materials.

Most of the professional attention which has been given to the social relations of science and technology has been located amongst senior government, industry and academic policy makers and analysts. This is particularly true in Developing Countries where explicit attention to these issues has been confined to small groups. Even in the Industrialised Countries a consideration of this field is only marginally integrated into general science education or into public consciousness. As a consequence the issues are not always comprehended sufficiently to ensure an informed public critical debate on crucial matters of policy.

Effective participation in a development process which genuinely contributes to the interests of the community as a whole, requires scientifically and technologically trained personnel to make choices and decisions on crucial matters of policy, and for this they require adequate understanding and information. The issues at stake are such that the understanding and information which is required must comprise not merely technical but also social and economic considerations. A population which is scientifically illiterate will be incapable of contributing to the formulation of policy and the making of technically based decisions, even though these matters may affect them profoundly. Equally, a population with some technical knowledge but no way of thinking about the social relations of science and technology will be no less impotent. In other words, a scientific and a social understanding are both necessary, but neither of them are sufficient conditions for responsible participation in decision-making processes in an industrialised or industrialising society. These matters are so important that most adult people have some rudimentary understanding at least of these matters. It is very rare, however, for the broad mass of (even) the (educated) people to be able to deal adequately with these important questions. What systematic understanding there is remains confined to those whose needs are already being met by the social and economic processes. It is therefore considered important that the social relations of science and technology are integrated into scientific and technological education.

Even in the Industrialised Countries it is difficult to integrate the social relations of science and technology into the educational syllabus. One of the major problems is that there is very little teaching material even at the level of higher education. There is a substantial amount of research material, but too little teaching material, and practically none which is appropriate for the secondary level. Therefore bibliographies rather like this one have been useful in the Industrialised Countries. In the case of Developing Countries while there is a complex and disordered set of

research material on the social relations of science and technology, there is practically no teaching material. This bibliography therefore does not contain more than a minute amount of ready-made teaching material suitable for use in Developing Countries, but it does contain material which should assist teachers, and those who train teachers, to prepare teaching materials with which to enrich the social aspects of their science and technology teaching.

This bibliography is, perhaps inevitably, a reflection of the teaching of Science, Technology and Society courses in the English-speaking Industrialised Countries. It is not our intention to suggest that these issues should be taught in the Developing Countries in a way which merely imitates their teaching in the Industrialised Countries. On the contrary, to teach them in that way would be to fail to appreciate the full significance of the key concept of 'appropriateness'. 'Appropriateness' has become one of the central concepts of the social studies of science and technology. The basic insight is that forms and types of science and technology which might be socially valuable in one context, country or time, are not necessarily valuable for another. Given that science and technology may be more or less appropriate to some context, exactly the same must be true of science and technology education, and also true of the teaching of the social relations of science and technology. In other words, we are not implying that teachers in Developing Countries should teach the social relations of science and technology in ways which might be appropriate in the Industrialised Countries, but rather that they develop their own syllabus and teaching methods which are appropriate and relevant to local conditions and needs. (See for example the International Baccalaureate pilot experiment cited in Section 2c.)

This bibliography, therefore, is intended to assist pupils, teachers, and teachers of teachers to think about the social relations of science and technology, so that they all can teach and learn about science and technology in ways which are socially relevant in Developing Countries. They are relevant precisely because they are essential to the processes of social and economic development. It is perhaps worth just a brief recapitulation of why science and technology are so important for the processes of development and industrialisation.

Britain was the first country to industrialise. One of the unique features of Britain's industrial revolution was that it occurred before Britain had established a proper system of science and technology education and without a wide involvement of scientists or technologists. Every other country which has subsequently industrialised and modernised has first had to organise and institute a formal system of science and technology education. In this day and age, without proper science and technology education, a country either does not develop or modernise at all, or it does so only in a state of extreme dependency. As a consequence of such a failure to institute proper science and technology education, the results of the development process are not necessarily, and frequently are not, entirely in the interests of the inhabitants of those Developing Countries. For example, unless a Developing Country has its own indigenous scientific and technological resources then industrial investment may come from multinational or foreign owned companies, which may take more money out than they bring in. They may introduce inappropriate technologies and patterns of consumption and trade. Furthermore, they may suppress local technological developments and

the growth of indigenous firms. They may also create social tensions or intensify existing divisions. If therefore industrialisation and modernisation are to serve the interests of the national and local communities and their development, rather than the industry and commerce of the Industrialised Countries, it is necessary for all Developing Countries to acquire scientific and technological capabilities, and these can only come from suitable systems of education. Even with such systems of education there can be problems of the migration of trained personnel to the labour markets of the Industrialised Countries. Consequently, education in the Developing Countries should equip and encourage people not just to emigrate with their newly acquired skills, but to contribute to the material and social needs of their community. It follows therefore that Developing Countries need appropriate science, technology and education just to cope with the changes going on around them and those which are thrust upon them.

The social and economic study of science and technology is not a field in which there are many permanent agreed truths. This is a contested field, and there are even disputes about how we should describe, discuss, theorise and examine this field. When science and technology become the subject matter of the social sciences the discussion inevitably depends upon ideological assumptions, and with this comes particular kinds of conflict. In this bibliography, therefore, we have tried to include material from many, if not all, sides of the debates. It is not the job of this bibliography to advocate any particular line, nor to exclude any line, but to provide an introduction to some of the material and the debates so that teachers and their pupils may have the opportunity of deciding for themselves in an informed and responsible fashion.

We have not assumed that those who will be trying to use this bibliography will be able to obtain more than a modest fraction of the material which we have listed. Hence we have chosen to include several items on particular topics to make it easier for the users of this bibliography to obtain at least some of the material.

How might this bibliography be used? In drawing up this annotated bibliography we have thought it desirable to list books which we think teachers can obtain, and might find it worthwhile to read. But we also list some books which we assume teachers will not be able to obtain, but for which the annotation itself might be useful. This latter category particularly includes books which are out of print but which have made important contributions to the field.

We consider it important that users of the bibliography should have some guidance on the question of how easy or difficult each particular text might be. We have therefore used what we hope is a simple system of coding for the entries comprising this bibliography. Material in Category I is material which is suitable for pupils to read and use. Unfortunately, in this field, and for pupils in Developing Countries, there are few texts available in this category. Teachers will therefore have to rely for the most part on materials in Categories II-IV. By Category II we mean material which is suitable for undergraduate students and for teachers, but probably not for pupils, because it is too demanding. We would expect teachers to find Category II material to be the most useful for their reading since it would be most readily adaptable for teaching purposes. Category III refers to material suitable for post-graduate and research students; while Category IV refers to material at the research front.

This bibliography is composed of five major sections, each of which is divided into two or more subsections. Each major section and each sub-section is provided with an introduction. Readers may wish to start by selecting specific topics from particular sub-sections, and this would present least problems for those who already have some knowledge of the field. If this bibliography is being used as an introduction to the entire field it is recommended, however, that the introductions be read as an ordered, interconnected and cumulative set. The introduction to each of the sections presuppose the preceeding summaries and introductions. This is, in part, because the sequence of the sections in this bibliography takes the reader from the most general topics sequentially to the most specific. Some benefit might be obtained by entering the bibliography at any stage, hopefully something extra can be gained by reading it through from the beginning.

It is quite possible that much of the material listed in this bibliography can be obtained from libraries. However, since this cannot be taken for granted we include in Appendix I a list of sources including the names and addresses of international agencies and publishers.

Section 1:
The social and economic role of scientific and technological knowledge and personnel

There have been human beings on this planet for approximately five million years. For most of this time we have lived as nomadic hunters, gatherers and herders. People have lived in settled rural agricultural societies for perhaps some ten thousand years. Science as we know it came into existence as recently as about three hundred years ago. The scientific revolution was a crucial part of the process that led to the industrial revolution which started in Britain approximately two hundred years ago. Industrialisation is a contagious process and has been spreading over the entire world, and into the Developing Countries particularly since the end of the Second World War. Taking a global and historical perspective it is therefore correct to say that industrial societies are recent and localised phenomena. They are also quite distinctive in the sense that societies which are based upon industrial technologies can only be understood in terms which are distinct from those appropriate to pre-industrial and pre-scientific societies. Science and technology are so fundamental to the modern world that it is becoming impossible to comprehend this world, and hence to know how to act in it, without an appreciation of the social significance of science and technology.

Science and technology provide human beings with a hitherto unparalleled capacity to control the material world. This power can be used, and is being used, both creatively and destructively. Science and technology have become such fundamental factors in social processes that the social questions concerning science and technology are not just important, they are actually vital. Science and technology were deliberately developed in western Europe from the seventeenth century onwards, and the social justification for this work was that they were to be agents of liberation. This liberation was to be both intellectual and material. Science was to give us true knowledge and liberate us from superstition and ignorance, and the technology which was to be derived from science would provide us with control over the material world. With this control we would be liberated from hard work, hunger, poverty, inadequate housing, poor health etc., and by eliminating material scarcity it would eliminate the causes of conflicts, and bring us peace and an end to war. That promise has yet to be fulfilled in its entirety. Material conditions remain severely restricted for many people in the Developing Countries for whom the promise might sound peculiarly empty. If we believe that the promise is a genuine one, even if its fulfilment is only one possibility, then we have to understand the social conditions necessary for that desirable result to come about. Or rather we need to grasp the complex interactions of the necessary social, material and technological conditions for science and technology to provide the real progress which they make possible.

This century has witnessed a whole series of re-evaluations of science and industrial technology as a result of perceptions of crises in which science and technology have been implicated. Long standing confidence in the ability of the scientific method to provide secure and complete knowledge was shaken by Einstein's rejection of Newtonian Physics, and its replacement by the Theory of Relativity. The development of Quantum Mechanics and its conflicting interpretations has only served to intensify these feelings of insecurity. Within the Philosophy of Science people have challenged the view that science has a unique or distinctive method, and many people have questioned and challenged the objectivity, universality and rationality of scientific knowledge. The ensuing debates remain unresolved, and positions taken on these philosophical issues have social ramifications.

Confidence in the benevolent character of science-based technology was particularly undermined by events of both World Wars. In the 1914-1918 War European scientists enthusiastically participated in the development of chemical weapons; and if anything the enthusiasm shown by the scientists in developing atomic weapons during the 1939-1945 War was even greater. In the economic field, the profound economic depression of the years between the Wars lead to a serious reappraisal, particularly in the work of J.D. Bernal, of the social function of science. Since 1945 major new controversies have also develped concerning the ecological significance and implications of industrial progress, and the cultural consequences of the replacement of traditional belief systems by science. The Developing Countries embarked on programmes of industrialisation, and there has been at least some disillusionment with the consequences of the changes which have come about, and with the direction of contemporary developments.

As a result of all these concerns the nature of science and technology, and their social relations have been systematically re-evaluated. Science and technology are no longer thought of as autonomous activities or as exogenous factors in social processes. Science and technology are now seen to be closely dependent upon human decisions, they are no longer thought of as being driven solely by an internal dynamic. It is now generally recognised that research and development (R&D) occur because people make deliberate choices to devote resources to these activities, and to some projects but not to others. Factories and research laboratories do not open, operate or close themselves. Governments and firms deliberate carefully on the question of how much they will spend on research and development, and how to focus those resources. Specific decisions are taken to develop or to deploy particular technologies, and to neglect others. In other words, science and technology are under the control of, at least some, people. Science and technology cannot therefore any longer be thought of as purely impersonal forces outside of human control.

There is, however, another side to the relationship. Scientific and technological developments have profound implications for the societies into which they are introduced, and from which they are withheld or withdrawn. To take just a few examples, the introduction of nuclear power stations will have implications for the production of, and demand for, other sources of energy, and these in turn have implications for the social and ecological environment. Similarly, the introduction of high yielding varieties of grains have social, economic and ecological implications for Developing Countries; and the precise consequences depend on the local conditions and cannot be inferred simply from the character of the technology.

The conclusion to be drawn from this discussion is that science and technology are dependent upon social processes, and that social progress is intimately connected with scientific and technological developments. Furthermore, a historical view of these inter-connections will reveal that science, technology and society have become increasingly interdependent, and we have every reason to expect this tendency to continue and to intensify.

This section of the bibliography is intended to provide an introduction to a wide-ranging discussion concerning the social and economic significance of firstly scientific and technological knowledge, and secondly scientific and technological personnel.

Section 1a: A general discussion of the social and economic role of scientific and technological knowledge

The material which is listed in this section discusses the many and various aspects of relationships between science and technology on the one hand and social and economic changes on the other. Each of the three elements which are discussed here namely: science, technology and society, are dependent on the other two. The precise character of that interdependence varies from case to case and through time, but it is almost entirely impossible to identify examples of thorough-going independence. In the material listed in this section there are discussions of a very wide range of different cases, and they are considered from a wide range of different points of view. This introduction can do little more than provide a summary of the topics which are considered, and a review of the extent of consensus and conflict which is to be found in the published works.

When Britain industrialised some two hundred years ago scientific and technological knowledge were not entirely irrelevant to those developments but their relevance was vastly slighter than it is to current developments. In the early part of the nineteenth century industrialists found that they had to turn to science to solve practical problems which arose as the scale of production increased and bottlenecks in production became troublesome. At this stage, science functioned rather like an auxiliary assistant to industrial developments. Perhaps more interestingly, industrial developments stimulated scientific research. For example, the desire to develop fuel-efficient steam engines in the nineteenth century, and to gain a systematic comprehension of the relative performance of competing engine designs lead fairly directly to the development of the science of thermodynamics. A subsequent, and particularly important, stage was reached in Europe in the late nineteenth century. At that time, we see the first establishment of new industries based directly upon developments in scientific research. The classic examples are the coal-tar dye industries in Germany and Britain, the pharmaceutical industry in Germany, and the electrical supply and consumer goods industries in Western Europe and North America. It was in these industries that we first encounter the privately-owned company research and development laboratories. These included not just university trained scientists and technologists with laboratory equipment, but also with technical assistance and libraries, as well as explicit company research and development policies. It was at this time that some people came to recognise that it was in their commercial and national interests to acquire, possess and nurture their own scientific and technological capabilities. Industrial developments in this century have been increasingly closely tied to scientific developments. The automobile industries, as well as those of tele-communications, synthetic materials, petrochemicals, aviation and electronics all serve as examples to demonstrate the increasingly close connections between changes in science, technology and economic activities. The establishment of all of these industries played a major role in the social history of the twentieth century.

On these matters there is a general consensus, but beyond this there is much which is disputed. In the first place there are disputes on the issue of whether or not we should seek to maximise the rate of scientific progress and technological changes; and perhaps more importantly which areas of science, and which kinds of technologies, should we seek to develop, how should they be utilised, and who should be making the relevant decisions. There are also extensive debates on the question of what determines the rates of scientific and technological change. Some authors argue that

military factors have played a crucial role while others emphasise the importance of commercial or political considerations. There is also much discussion on the question of whether economic changes are primarily responsible for developments in science and technology or whether economic progress is the product of scientific developments. There are also complex debates concerning the extent to which it is the responsibility of governments to stimulate and regulate technological progress. Those who determine, and implement, policies for science and technology do so, as a rule, upon the advice of scientists and technologists. Scientific and technological beliefs are themselves therefore caught up in these controversies. It is increasingly rare to encounter a statement or a defence of the view that science and technology are socially neutral. There is, however, a very wide spectrum of views on the question of what the precise social significance of science and technology are, or can be; and hence there are wide ranging debates about science and technology policies.

So far, the introduction to this section has dealt in quite general terms with issues concerning the social and economic relevance of science and technology to countries of all different sorts. There are, however, a set of important questions and issues specifically about the social and economic significance of science and technology for the Developing Countries. The circumstances of a country which is currently seeking to industrialise are entirely different from those which confronted Britain two hundred years ago, or even from those confronting Japan one hundred year ago. The relationships between Developing Countries and the already Industrialised Countries today is such that the Developing Countries are faced with a whole set of difficult yet urgent questions about the social and economic roles of science and technology in their communities. These are the focus of a whole set of specialised, and hotly contested, debates. Much of the material presented in this section is addressed to these important matters.

Section 1a: The social and economic role of scientific and technological knowledge

Agassi, J., Science and Society: Studies in the Sociology of Science, D. Reidel, Dordrecht, Holland, 1981

IV A highly scholarly and quite individual treatment of a wide range of issues in the sociology and philosophy of the sciences. The volume contains 34 chapters and ranges widely from the social and historical meaning of science and scientific progress to the practical organisation of scientific publishing.

Albury, D. & Schwartz, J., Partial Progress, Pluto Press, London, 1982

II A polemical book in which the authors argue that science and technology have developed, and do develop, in ways which serve the specific purposes and interests of managers, employers and governments. It argues further that the work of scientists and technologists has not been uniformly beneficial nor morally or politically neutral. It is aimed at groups and individuals who are struggling with science which is presented as neutral, but which is in practice partisan.

The Ann Arbor Science for the People Editorial Collective, Biology As A Social Weapon, Burgess Publishing Company, Minneapolis, 1977

II Ten papers with appropriate introductions which deal with several aspects of the social meaning of some features of orthodox biological theory. The main theme is to provide a critique of biological determinism of human social actions and institutions. The introductory section is a paper by Richard Lewontin on 'Biological Determinism as a Social Weapon', and subsequent chapters deal with race and intelligence quotients, sex roles, aggression, the environmental crisis and sociobiology.

Baark, E., Elzinga, A. & Borgstrom, B.E., Technological Change and Cultural Impact in Asia and Europe: a Critical Review of Western Theoretical Heritage, Research Policy Insitute, University of Lund, Sweden, 1980

III Three articles on the cultural impact of science and technology written from a comparative perspective, plus three corresponding selective bibliographies of relevant works primarily in English.

Baranson, J. (Ed.), Technology for Underdeveloped Areas: An Annotated Bibliography, Pergamon Press, 1967

III Deals with technology in production in twelve major product sectors including food, housing, and energy, ranging widely over different countries and regions. Also includes references on education and institutionalisation of science.

Basalla, G., 'The Spread of Western Science', Science, Vol. 156, 5 May 1967, American Association for the Advancement of Science, pp.611-620

II A classic and important paper which provides a condensed account of the introduction of Western science into non-European nations. The author provides a three stage model which he takes to be of quite general applicability. In the first phase the non-scientific society or nation provides a source of data or problems for European Science. Phase two is termed colonial science, while phase 3 involves the struggle to evolve and achieve an independent scientific tradition. He identifies some seven conditions or tasks which must be completed before a scientific community in a Developing Country can be truly autonomous.

Behari, B., Economic Growth and Technological Change in India, Vikas Publishing House, Delhi, 1974

III Based on direct experience of Indian economic activity, this work reviews some of the crucial aspects of technological adaptation to natural endowments and human skills. The author evaluates the relationship between the changes which occur in agriculture and industry, demography and technology. He discusses the nature of appropriate technology, problems of technology transfer and the social impact of new technologies. Particular attention is also given to small industries and backward regions, to the role and status of women in India, and to Chinese science and technology policies.

Bernal, J.D., The Social Function of Science, Routledge, 1939, reprinted 1980, R. West

II A seminal work in the historical development of an awareness of the social significance of science, and of the requirement for national science and technology policies. His theoretical framework is orthodox marxist and while much of his data is out of date, the theoretical ideas remain robust and potentially relevant. How it might be made relevant to Developing Countries has been much discussed by Furtado, 1964; Subrahmaniam, 1972; Heneza, 1972; Cervantes, 1970; Sunbeland Puz, 1970.

Bodington, S., Science and Social Action, Allison & Busby, London, 1978

II A discussion intended for the non-specialist of the relations between knowledge and the social order, and the problems of planning in both market and socialist economies. It reviews the important role of models in both science and society, and concludes with a discussion of possible strategies for overcoming the undemocratic and anti-democratic ways in which some technologies are introduced.

Boyle, C., Wheale, P.R., & Sturgess, B.T., People, Science and Technology, Wheatsheaf, 1983, £5.95

II A modern introductory textbook on the social relations of science and technology intended primarily for students of science and technology. The book has thirteen chapters in three parts. The first is a review of the major disciplinary perspectives (historical, philosophical, sociological, political and economic) aspects of science and technology. The second synthesises these perspectives in a wide ranging review of six key areas including food and agriculture, energy, health and medicine. The third part examines commonly revealed themes concerning the social control of science and technology, and science and technology as a means of social control.

Boyle, G., Elliott, D., Roy, R. (Eds.), The Politics of Technology, Open University Press & Longman, 1977

II This text was produced for the Open University course Control of Technology (T361) and it is a collection of 28 articles which examine the regulation of technology and the positive redirection of technological change to respond to human, social and environmental needs. The main section headings are: Social Control of Technology, Government and Technology, Public Involvement in Technology, and Decentralised and Community Technology; it concludes with an annotated guide to further literature.

Cardwell. D.S.L., Technology Science and History, Heineman Educational Books, London 1972

II A classic textbook discussion of the changing patterns of interaction between science, industrial technology and economic changes from the Scientific Revolution of the 17th century to the middle of this century. Shows clearly the ways in which science has become increasingly important to economic development. Suitable for teachers and pupils of 15+

Carroll, J., 'Participatory Technology', Science, Vol. 171, 19 Feb. 1971, American Association for the Advancement of Science, pp.647-53

II An examination of public participation in the development, use and regulation of technology. The author first analyses some indications that participatory technology may be emerging as a trend, he then considers some different forms of this trend and finally evaluates some of its implications. The author draws heavily on examples from the U.S. experience, but the general concepts and problems which are introduced and assessed are of potentially broader application.

Casper, B.M., 'Technology Policy and Democracy, Science, Vol. 194, 1 Oct. 1976, American Association for the Advancement of Science, pp.29-35

II During the 1970's there was a series of proposals for a "Science Court" which would deal with the technical aspects of controversial public issues. One of the purposes of this idea being to separate institutionally scientific and technological questions from those concerned with politics, economics and ethics. It was proposed that the "judges" should be "established experts in areas adjacent to the disputed issue". The author introduces some criticisms of the proposals, because for instance, he argues that the selection of which scientific and technological matters are deemed to be significant is already to make a value judgement which may be political. Furthermore he doubts that it is even desirable to separate the scientific questions for independent consideration.

Collingridge, D., Leaps in the Dark: The Social Control of Technology, Francis Pinter, London, 1981

II According to the author the appropriate characteristics of decision-taking under ignorance, as is the case in the social control of technology, is a process involving the selection of an option best suited to achieve a given objective at one time, the continuous monitoring of the outcome of the decision and the conscious search for new information which can be used to modify the initial choice. Thus preference should be given to technological options which are easy to monitor, entail low costs of error correction, possess a low response time to corrective action and are flexible in the sense of closing as few as possible of future options.

Cooper, C. (Ed.), Science, Technology and Development: The Political Economy of Technical Advance in Undeveloped Countries, Frank Cass, London, 1973

III A demanding, but rewarding statement of many of the complexities confronting Undeveloped Countries in the articulation and implementation of science and technology policies for economic development; exploring in particular problems of dependency and the transfer of technologies.

Cooper, C., "Science, Technology and Production in the Underdeveloped Countries: an Introduction", Journal of Development Studies, Vol.9, No.1, Frank Cass, London, 1972

III A timely argument against oversimplified views of the potential contribution of science and technology to economic progress in Developing Countries. The argument is that science and technology tends to be a form of consumption rather than investment for most Developing Countries, and this is because technology is often imported from advanced countries, and not produced by indiginous groups for local needs. Problems are further complicated by patterns of ownership and by demands placed on scarce resources for the operation of the inappropriate technologies.

Cross, N., Elliott, D. & Roy, R. (Eds.), Man-made Futures: Readings in Society, Technology and Design, Hutchinson Educational Press with The Open University, 1974

II 38 articles, or excerpts from articles plus an editors' introduction, designed to form an essential and integral part of the British Open University Course T262 on "Man-Made Futures: Design and Technology". The first section deals with the sources and effects of technological change in industrial society, with criticisms of modern 'technocratic' society and with concepts of a future 'post-industrial' society. The second section is concerned with newly emerging mechanisms for the social control of technological change, such as technology assessment, futures forecasting and community participation in planning and design. The third section is concerned with the processes of innovation and design and with movements towards such concepts as 'humane' or 'alternative' technologies.

Durbin, P.T., A Guide to the Culture of Science, Technology and Medicine, The Free Press, New York, & Collier Macmillan, London, 1980

III An in-depth survey of the literature of the history, philosophy and sociology of science, technology, medicine, and the expanding field of bioethics. The volume is composed of 9 chapters organised into 4 parts. Part I reviews the histories of science, technology and medicine; Part II deals with the philosophy of science, technology and medicine; Part III deals with the sociology of science and technology and with medical sociology and science and technology in medicine; Part IV reviews science policy studies.

Easlea, B., Liberation and the Aims of Science: An Essay on Obstacles to the Building of a Beautiful World, Scottish Academic Press, Edinburgh, 1980

II A potential course text which arose from a set of lectures on 'Science and Society' for students of science. It portrays science not as the abstract pursuit of knowledge for its own sake but as part of several social projects. The central aim may be the social, material and intellectual liberation of humanity, but science also plays a variety of roles in destructive and oppressive projects. The author located science in its historical and international context and addresses the question of why science is not serving the overriding goal of liberation, and of the conditions which must be satisfied for science to contribute effectively to "the building of a beautiful world".

Fischer, R.B., Science, Man and Society, W.B. Saunders, Philadelphia, London & Ontario, 1971

II A brief American college text intended for science students to provide them with some resources with which to think about science. The book opens with an attempt to define science, and then to present science as a human activity. It discusses the nature of technology and the relationship between science and technology; then considers the character of science education, and issues of science and public policy.

Forje, J.W., Science and Technology for Development in Africa South of the Saharah, Research Policy Insitute, University of Lund, Sweden, 1982

III A bibliography of some 650 entries which though useful, is not annotated. It is well organised, since entries are listed alphabetically and also by subject and region. There are thirteen subject categories, and five regional divisions.

Freeman, C., The Economics of Industrial Innovation, Penguin Books, Harmondsworth, 1974; reprinted F. Pinter, 1982

II A very useful general text on the problems and possibilities for science-based industries. The discussion refers primarily to developments in the industrial countries, but the analytical tools are of global relevance.

Freeman, D.M., Technology and Society: Issues in Assessment, Conflict, and Choice, Rand McNally, Chicago, 1974

III The text deals with technology assessment, social conflicts and planning. It is not an analysis of particular problems but rather an attempt to identify the ideas and theories necessary to analyse particular issues. It provides a general discussion of technology as a social phenomena and argues for the importance of technology assessment. It explores the problems of specifying the criteria by which technological changes might be assessed, and it critically reviews the methods used in the USA for assessing such changes.

Fuller, W. (Ed.), The Social Impact of Modern Biology, Routledge & Kegan Paul, London, 1971

II A set of twenty articles which seek to establish the social implications of developments in biology. The volume is based on a conference held in 1970 and organised by The British Society for Social Responsibility in Science. The volume is divided into six parts. Part I is a general discussion of science, technology and values. Part 2 considers molecular genetics. Part 3 deals with human genetics and reproduction. Part 4 is concerned with immunology and cancer. Part 5 with agricultural botany and the environment, and finally part 6 discusses Science in Society.

Gibbons, M. & Johnston, R., 'The Role of Science in Technological Innovation', Research Policy, Vol. 3, No. 3, Nov. 1974, Elsevier Science Publishers, Amsterdam, pp.220-242

III Within an overall goal of seeking to quantify the economic benefits of scientific research, this paper distinguishes four types of benefits that might flow from scientific research. The benefits of trained manpower, cultural benefits, the direct benefits of applied reasearch and benefits resulting from the subsequent application of fundamental ideas discovered through curiosity-orientated research. It then reports a study into the various mechanisms by which scientific research and education can contribute to industrial innovations. This study demonstrates the value of devoting scarce resources to scientific research and development, but leaves open the question of how to decide precisely which areas should be priorities for those resources.

Goldsmith, M. & King, A. (Eds.), Issues of Development: Towards a New Role for Science and Technology, Pergamon Press, Oxford & New York, 1979

III The collected papers from a conference organised by the United Nations Commission on Science and Technology for Development. This particular volume records the International Symposium held in Singapore in 1979. This volume contains 40 papers, some of which provide an overview, while others consider the development of indigenous scientific and technological capabilities in Developing Countries, as well as Education and Training, Information and Communication, Food, Population and Employment; and the Roles of Scientists and Technologists.

Green, K., & Morphet, C., Research and Technology as Economic Activities, SISCON, 1975; Butterworths, for SISCON 1977

II A classroom text intended as an introduction to the economic role of research and technology. Attention is restricted to research and technology in the private sector of industrialised economies, but the ideas introduced are of broader relevance. The text deals with the importance of national and international competition for products and processes, technological change and growth, policies of firms, and the diffusion of innovations. The text includes empirical data, questions for use in classrooms (and some answers) and an annotated bibliography.

Gvishiani, J., Science, Technology and Global Problems: Trends and Perspectives in Development of Science and Technology and Their Impact on the Solution of Contemporary Global Problems, Pergamon Press, Oxford & New York, 1979

III A report of a conference in the USSR held in January 1979 in preparation for a United Nations Conference on the Application of Science and Technology to Development. The papers discuss a very broad range of topics and look forward to the problems and opportunities between now and the year 2000. This volume is one of a set of four. The others are: Goldsmith, M. & King, A. (Eds.), Science, Technology and Global Problems, Singapore - Issues of Development: Towards a New Role for Science and Technology; Radhakrishna, S. (Ed.), Science, Technology and Global Problems, Kuala Lumpar - Views from the Developing World; and Urquidi, V.L. (Ed.), Science, Technology and Global Problems, Mexico City: Science and Technology in Development Planning.

Hall, A.R., Science for Industry: A Short History of the Imperial College of Science and Technology and its Antecedents, Imperial College of Science and Technology, 1983

III A history of one of Britain's foremost institutions of science and technology education from its inception until its prosperity in the 1960's and 1970's. It details in particular the contributions of industries and governments to the achievements and difficulties of the college, and is written from a conviction that science and technology education can be invaluable commercial and military assets to governments; and that they should consequently recognise their responsibility to education. There is no discussion of the difficulties occasioned by the financial stringencies on the universities and the Research Councils in the period 1981-1984.

Herrera, H., 'Social Determinants of Science Policy in Latin America', Journal of Development Studies, Vol.9, Oct. 1972, pp.19-37

III An account of some of the reasons why science and technology are not successfully integrated into the productive sector in several Latin American economies, and policy proposals for suitable reforms.

Himsworth, H., The Development and Organization of Scientific Knowledge, Heineman, London, 1970

III The author is a British expert in biomedical science with extensive experience of the administration of British science. The author reviews several developments in biomedical science and introduces a model of the structure and development of scientific knowledge. On the basis of that insight he seeks to draw out some implications for the organization, administration and funding of scientific research and development.

Hobday, M., 'The impact of mocroelectronics on Developing Countries: The Case of Brazilain Telecommunications', Science Policy Research Unit, Brighton, England, 1984

II This paper argues that there are major potential economic benefits to be gained from the application of microelectronics in telecommunications in Developing Countries. It is, however, vital that Developing Countries identify and acquire the technological capacity necessary to install and expand their telecommunications infrastructure so that they can avoid technological dependency. The Brazilian experience shows that it has been possible for a Developing Country to acquire a major capability in digital technology in a relatively short period of time, and that considerable economic benefits can follow from this investment. The Brazilian case also shows that there has to be co-ordinated intervention and investment from governments if the potential benefits are to be achieved.

Hoos, I.R., 'Societal Aspects of Technological Assessment', Technological Forecasting and Social Change, Vol. 13, No. 3, 1979, Elsevier, New York, pp.191-202

III Usually, technological assessment purports to deal with social impacts and institutional arrangements. In practice, however, more often than not, these aspects of technological changes are ignored in technological assessment. This paper provides a critique of the assumptions and methods of technology assessment and argues that contemporary methods are no more reliable at assessing the uncertain future than previous methods have been at managing the present.

Jevons, F.R., Science Observed, George Allen & Unwin, London, 1973

II A well digested textbook which discusses the increasing importance, and problems, of science for society. It reviews both the economic importance of science in industry, and the intellectual and social habits of the scientific community. Based mostly on British experience, but of broader potential relevance.

Johnston, R. & Gummett, P. (Eds.), Directing Technology: Policies for Promotion and Control, Croom Helm, London, 1979

III The direction of technology to socially useful ends has become one of the major preoccupations of science and technology policy. Governments, firms and others wish to promote new technologies while governments and citizens also wish to regulate the undesirable side effects of some technolgies or to ban them altogether. This book explores these problems through 13 studies of policy options and decision making processes. The examples are taken from the Industrialised Countries and deal for example with nuclear power, aviation, motor vehicles, pesticides and recombinant D.N.A.

Johnston, R. & Robbins, D., 'The Development of Specialities in Industrialised Science', Sociological Review, Vol. 25, 1977, Routledge and Kegan Paul, pp.87-108

III This paper attempts to draw together two traditions of research. One dealt in general terms with the social relations of science and the other with the internal social organization of the scientific community. This paper provides an analysis of professionalization and occupational control and focuses on the processes of differentiation within science, and seeks to establish the consequences of these changes for the cognitive and normative structures of science.

Jones, G., The Role of Science and Technology in Developing Countries, OUP, 1971

II The purpose of this book is to examine some of the ways in which modern science and technology can help to promote economic and social growth in poor Developing Countries. It discusses in general terms the potential roles for science and technology in economic development, and concentrates, inter alia, on agricultural development and problems of education and skill provision.

Langrish, J., Gibbons, M, Evans, W.G. & Jevons, F.R., Wealth from Knowledge: A Study of Innovation in Industry, Macmillan, 1972

III A systematic attempt to come to grips with the economic significance of science-based innovations and technological changes. The study is in three parts. The first part is a general review of questions, theories and problems. The second contains some quantitative results, and the third consists of 36 case-studies of major product and process innovations in British industry.

Landes, D.S., The Unbound Prometheus: Technological Change and Industrial Development in Western Europe from 1750 to the present, Cambridge University Press, 1972

II A thorough survey of the role of technological change in the global process of industrialization and modernization. The author is particularly successful in describing and explaining the complex interactions between technological changes and social, economic and international factors.

Laudan, L., Progress and its Problems: Towards a Theory of Scientific Growth, Routledge & Kegan Paul, 1977

III In response to what the author justly perceives as a crisis of confidence in the validity of scientific knowledge, he seeks a fresh approach to providing an analysis of the rationality of science. This approach turns its back on the two major responses to the crisis so far. These responses have been either complacency or despair. This author rejects both those options and seeks to avoid the errors of both approaches. He develops instead a model of how science progresses and deals in passing with many of the weaknesses of the theories of competing scholars. He completes his book with an account of the applications of his model to the history, philosophy and sociology of science.

Lawless, E.W., Technology and Social Shock, Rutgers University Press, New Brunswick, New Jersey, 1977

II This study deals with the responses of the publics of Industrialised Countries to revelations of risks from specific new technologies. The author reviews in detail forty-five particular cases including such matters as bans of low calorie cold drinks and deodorant sprays, the Alaska pipeline and the rise and fall of the pesticide DDT. He also provides brief synopses of a further 54 cases. The book concludes with a section of analysis and reflection which seeks to draw general lessons from the many diverse examples. In particular it explores the implications for government regulation and policy, for industry, trade unions, education and for consumer groups.

Lipscombe, J. & Williams, W., Are Science and Technology Neutral?, Butterworths, for SISCON, 1979

II A classroom text which reviews arguments for and against the belief in the social neutrality of science and technology. The first part considers science, both pure and applied, and examines it in terms of its results, methods and process. Section two considers technology both in terms of products and their use. The final section deals specifically with intermediate technologies intended for use in Developing Countries, and their social meaning and impact.

Machlup, F., Knowledge. Its Creation, Distribution, and Economic Significance. Vol. I. Knowledge and Knowledge Production, Princeton University Press, New Jersey, 1981

IV A rare attempt to provide a comprehensive review of the social and economic significance of knowledge, including scientific knowledge. The author reviews different types of knowledge, the qualities of knowledge, and its production and utilization.

Martin, B., The Bias of Science, Society for Social Responsibility in Science, P.O. Box 48, O'Connor, Australian Capital Territory 2601, Australia, 1979

II This text starts from two scientific papers which serve as case studies. They deal with pollution to the upper atmosphere by super-sonic aircraft. The author of the text argues that the writers of the papers push their arguments in various ways so as to seek to sustain conclusions which are not entirely supported by the evidence which they can present. He seeks to explain this practice by reference to an account of what the scientists are trying to prove. Having uncovered the presuppositions behind some scientific work, the author then applies his approach to some other examples of scientific work. The idea of presuppositions to scientific work is then used to explore the structural biases underlying science in general. The discussion concludes with a case for self-managed science, which is a science participated in by all members of a self-managed and non-heirarchical community.

Mayor, F., Scientific Research and Social Goals: Towards a New Development Model, Pergamon Press, Oxford & New York, 1982

III This publication draws on the results of a UNESCO programme on 'Research and Human Needs'. Collectively the 19 papers included here address such questions as: Why do scientific research at all? For whom are its results intended? What is meant by development? How are priorities for development set? There is an extensive discussion of how scientific and technological research can be made relevant to human needs in Developing Countries, how those needs might be determined and how science and technology policies can be modified to contribute most effectively to their satisfaction.

Mazur, A., 'Disputes Between Experts', Minerva, Vol.11, No.2, 1973, 59 St. Martins Lane, London WC2N 4JS, pp.243-62; reprinted in Mazur, A., The Dynamics of Technical Controversy, Communications Press, Washington, D.C., 1981

II A review of different kinds of disagreements which can occur between scientific experts, particularly in the context of public controversies. Drawing primarily on the examples of fluoridation of drinking water and the toxicity of low levels of nuclear radiation, the author examines rhetorical devices and other techniques upon which experts rely in situations of public controversy. He concludes by reviewing several possible strategies for dealing with such disputes and he tends to prefer an adversarial approach, despite its limitations.

Michael, I., 'Academic Autonomy and Governmental Demands: The Case of Malawi', Minerva, Vol. XVI, No.4, 1978, 59 St. Martins Lane, London WC2N 4JS pp.465-79

II A partial report on nine years of experience at the University of Malawi by the former Vice-Chancellor of that country's first university. The paper includes a brief but useful discussion (pp.472-4) on the social relevance of education.

Millstone, E., The Social Impact of Science and Technology, SISCON, 1979

II A set of 99 slides, many of which carry two images which sometimes complement each other, and sometimes are in contrast. The slides are accompanied by a booklet which provides a commentary. The slide set was originally conceived as a way of introducing a class to the subject of Science, Technology and Society, but it could also be used to review the subject at a later stage in a course. The text provides teachers with a commentary, but they may prefer to develop their own commentary or to invite pupils to provide their commentary, or to stimulate class discussions. The set is organised into sections. It starts with a general introduction and then deals with the topics of work, food, health care, housing, transportation, the environment and with military technology. It concludes with a few examples of the appropriate and particularly creative uses of science and technology.

Morehouse, C.T. (Ed.), Science and Technology for Development: International Conflict and Cooperation. A Bibliography of Studies and Documents Related to the 1979 United Nations Conference on Science and Technology for Development, Research Policy Institute, University of Lund, Sweden, 1980

III A thorough and comprehensive bibliography organised and indexed both by topic and by region, containing some 3570 entries.

Nader, C. & Zahlan A.B., Science and Technology in Developing Countries, C.U.P., 1969

III A record of the proceedings of a conference on 'Science and Technology in Developing Countries' which dealt with the problems and possibilities of planning the development and application of modern science and technology specifically in relation to the Arab Middle East and Turkey; and was held in Beirut in 1967. Topics covered include the links between science, technology and goals of national development, the organisations and institutionalization of science and technology.

Nelkin, D. (Ed.), Controversy: Politics of Technical Decisions, Sage Publications, 1979

II Twelve articles and an editor's introduction to debates concerning conflicts over technologically based issues. The volume is divided into four sections. Part I is called 'Efficiency versus Equity', Part II deals with 'Benefits versus Risks', Part III is on 'Regulation versus Freedom of Choice', and Part IV is on 'Science versus Traditional Values'.

Norman, C., The God that Limps: Science and Technology in the Eighties, W.W. Norton, New York, 1981

II This book is intended to provide a critical analysis of the role of science and technology in the world economy. The author argues that the world's 150 billion U.S. dollars per year which is invested in research and development would be more suited to the military policies of the 1950's than to the social needs of the 1980's, and that current policies in major Industrialised Countries are actually making things worse. He explains the recent slump in industrial innovation in terms of an adjustment to higher energy prices and from old technologies to ones based on micro-electronics and genetic engineering. He argues that the Developing Countries urgently require a technological transformation but that special care must be taken if policies are to ensure that the gap between rich and poor does not deepen even further.

Norris, K. & Vaizey, J., The Economics of Research and Technology, George Allen and Unwin, 1973

IV A demanding but rewarding text on the economic role of science and technology and industrial innovations. The authors are careful to distinguish science from technology and between basic, pure and applied research, and research from development and invention from innovation. They then consider questions of research and development expenditures, patents, research and development policy of firms, innovations and their diffusion as well as the impact of technical change of national growth rates and the international transfer of technology; and finally the economic consequences of technological change on productivity, competitiveness, wages, profits and prices.

Organisation for Economic Co-operation and Development, Technology on Trial: Public Participation in Decision-Making Related to Science and Technology, OECD, Paris, 1979

III This is a report which summarises the findings of a comparative study of different participatory mechanisms and experiences in the OECD countries. It discusses the general issue of public participation, informing the public and the policy makers, methods for reconciling conflicting interests and ways of reaching collaborative decisions.

Pacey, A., The Culture of Technology, Blackwell, 1983

II This book examines what are often conflicting attitudes towards nuclear weapons, biological technologies, pollution, third world development, automation, social medicine and to industrial decline in Britain. The author denies that technology is value-free and argues that its use is conditioned by political and cultural factors. He argues for a general recognition of the values implicit in technological developments and discusses the necessity of ensuring that they are a proper reflection of our own values.

Passmore, J., Science and Its Critics, Duckworth, London; & Rutyers University Press, Brunswick, New Jersey, 1978

III An ordered set of four essays which were written in response to a lecture by Oscar Mendelsohn entitled 'The Revolt Against Science' which was published in Search, Vol. 3, 1972, pp.415-22. As Passmore says, criticism of science is almost as old as science itself. These essays provide a systematic critical review of criticisms of science. He deals firstly with complaints that science is able to answer too narrow a range of questions, then with objections to the use of science-based technologies, and to the intellectual spirit of science. As he writes, he replies to many of these objections, and concludes with a reasoned account of the strengths and weaknesses of science as a major element in our intellectual and social histories.

Pavitt, K., & Worboys, M., Science, Technology and the Modern Industrial State, Units 1-3, and Teacher Text, SISCON, 1974; Butterworths, London, for SISCON

II A text for pupils and students, with a separate teacher text, on the roles played by science and technology in modern industrial society. The authors adopt an interdisciplinary approach which brings together historical, social, economic and political considerations, and seeks, at least to provide the main concepts with which to understand the complex and changing interactions between science, technology and society. Particular emphasis is placed on the historical and contemporary role of military factors in scientific, technological and social developments. The material is well organised for teachers with questions, seminar, essay and project topics. It also has valuable excerpts of readings and bibliographies.

Pavitt, K. (Ed.), Technical Innovation and British Economic Performance, Macmillan, 1980

III A collection of papers which together constitute a study of the rate of technological change in British industry as regards both product and process innovations. It demonstrates that by comparison with other major Industrialised Countries, Britain has markedly low rates of innovation; and it is argued that this provides a crucial element in any proper explanation of Britain's relatively poor economic performance.

Rahman, A. & Chowdhury, P.N. (eds.), Science and Society, CSIR, New Dehli, 1980

II An extensive collection of 34 articles on the social role of science in Developing Countries drawing particularly on the Indian experience. It is divided into five major sections and includes material particularly on education, agriculture and health care in rural areas of undeveloped countries.

Rahman, A., 'The Interaction between Science, Technology and Society: Historical and Comparative Perspection', in International Social Science Journal, Vol.33, No. 3, 1981, Paris, UNESCO, pp.508-521

II A review article in which the author seeks to show by reference to several historical and contemporary examples that science and technology frequently develop in ways which are determined by social forces, and that science and technology are neither autonomous or independent. This article is unusual in that it draws primarily on examples from non-European cultures.

Rahman, A., The Cultural and Philosophical Roots of Scientific Tradition, National Institute of Science Technology & Development Studies, 1983, NISTADS, Hillside Road, New Delhi-110012

II A critique of, and an alternative to, the orthodox western view that science arose only in the west because non-western societies were too rigid and stagnant. The author argues that this mistaken theory has lead scholars to ignore early scientific and technological traditions in non-European countries; and to distort the record in other serious ways. The author discusses developments in India, China, Japan and in Islamic societies and briefly reviews their contributions to an understanding of the natural world. He then introduces a large scale historical model of the evolution of the scientific tradition which serves to encompass the contributions of many non-western cultures.

Reingold, V. & Molella, A. (Eds.), 'The Interaction of Science and Technology in the Industrial Age', Technology and Culture, Vol. 17, No. 4, Oct. 1976, Chicago University Press, pp.621-745

IV A set of eight articles drawn from the proceedings of the Burndy Library Conference in Norwalk, Connecticut in March 1973. The assumption behind the conference was that the historical relations between science and technology are not simply natural phenomena but that they are basically ideological and concern the fluid social relations and the status of groups adjusting in relationship to each other. The participants at the conference were agreed that technology is not simply applied science, but beyond that a wide diversity of views are expressed.

Rosenberg, Perspectives on Technology, Cambridge University Press, 1976

III A well respected text on the economics of technology and innovation. It is essentially a collection of the author's papers, but it is a collection which functions as a whole. The author argues that it is not possible to analyse the effects of technological change independently of the particular context in which it is utilised, for the same technology will have very different consequences in societies with different institutions, values, resources and histories. The book is divided into four parts. Part 1 is entirely historical, and deals with the emergence into the American economy of machine tools and woodworking machines. Part 2 reviews the concepts with which economists have analysed the creation of new technologies. Part 3 reviews the determinants of the speed and extent of the diffusion of new technolgies once their peasibility has been established. Part 4 is entitled: 'Natural resources, environment and the growth of knowledge'.

Rottenberg, S., 'The Economy of Science: The Proper Role of Government in the Growth of Science', Minerva, Vol. XIX, No.1, 1981, 59 St. Martins Lane, London WC2N 4JS, pp.43-71

III A discussion of the role which governmental interventions should play in the scale and direction of scientific work in a mixed economy. The author, operating within orthodox economic theory seeks to identify failures in the market mechanisms which would require specific government action. The author then reviews the science policy of the governments of the USA and identifies some "flaws" in these policies. He proposes therefore the form which he thinks government science policies should take.

Russell, C., Science and Social Change 1700-1900, Macmillan, 1983

II This book was intended to serve as a general introduction, or as a student text, on the social history of science. The book seems to describe and explain the multitude of ways in which science has reflected, influenced and become part of processes of social change. The focus of the book is on the British and French experiences and traces the transformation from science as the preoccupation of gentlemen and amateurs, through the Industrial Revolution to science as a disciplined, hierarchical and professionalised activity organised by and for industries and governments.

Sklair, L., Organised Knowledge: A Sociological View of Science and Technology, Paladin, 1973

II A useful introducing to facts and theories about scientists and engineers in their economic and social contexts. While Sklair concentrates on the industrialised countries (and especially on the U.K.) the questions asked and answers offered are of a far broader relevance. Suitable for teachers and older pupils e.g. 16+

Skorov, G.E. (Ed.), Warren, J. (Trans.), Science, Technology and Economic Growth in Developing Countries, Pergamon Press, 1978. First published in 1975 by Mysl Publications in Russian.

II Six chapters on science, technology and economic growth in Developing Countries as seen by orthodox Soviet economists, includes specific discussion of co-operation between Developing Countries with socialist block countries.

Spacey, J., et.al., Science for Development: An Essay on the Origin and Organization of National Science Policies, UNESCO, Paris, 1971

II This volume, originally published in French in 1969, analyses the currents of thought and action which characterise national science policies among the European states, and outlines many of the problems which face those responsible for governmental development policies based on science. It discusses science as a means of development, and as a factor in economic growth and cultural changes. It records the resources and the deployment of research and development. It identifies four connected functions which a policy for science should fulfil, and considers the potential for enhanced international co-operatives.

Spiegel-Rosing, I. & de Solla Price, D., Science Technology & Society, Sage, London & Beverley Hills, 1977

III An exceptionally authoritative review of the entire field of the social relations of science and technology by leading international authors, including a powerful survey of debates concerning science and technology in Developing Countries, and some discussion of educational matters.

Teich, A.H., & Thornton, R. (for the American Association for the Advancement of Science), Science, Technology and the Issues of the Eighties: Policy Outlook, Westview Press, Boulder, Colorado, 1982

III This is a report commissioned by the U.S. National Science Foundation and aims "... to identify and describe national problems in which scientific and technological considerations are of major significance and which warrant special attention by policy makers during the next five years." The report is in several parts, the first on applied science and technology in the U.S., and it then deals with science, technology and international security. It also considers technological progress in Developing Countries, U.S. agriculture and the world food situation, materials and energy resource depletion, and science and national defence. The chapters which constitute this work are not of a consistent quality and the volume fails to provide a comprehensive framework of analysis, but it contains a great deal of useful information which may be used for teaching.

Thomas, D.B. & Wionczek, M.S., Integration of Science and Technology with Development: Caribbean and Latin American Problems in the context of the U.N. Conference on Science and Technology for Development, Pergamon Press, 1979

III A collection of twenty articles covering many of the topics surveyed in this bibliography from the point of view of central and south America. It is organised into five main sections dealing with (I) Building Science and Technology Capabilities; (II) Infrastructure and Technology Transfer; (III) Technological Problems in the Caribbean; (IV) Science and Technology Policies in Latin America; and (V) the U.N. Conference on Science and Technology for Development. Despite its restricted geographical base, the ideas presented have a more general relevance to Developing Countries.

UNESCO, Impact of Science on Society

II Published by UNESCO since 1948 dealing thoroughly with a very wide spectrum of issues and opinions: since 1968 each issue has focussed around a specific topic.

UNESCO, Societal Utilization of Scientific and Technological Research, UNESCO, Paris, 1978

III The Introduction to this study reviews some of the main relationships between science and society and discusses contemporary trends in the reorientation of societal utilization of scientific and technological research. Part I examines existing models of societal utilization of research results: Part II suggests an alternative approach to societal utilization of scientific and technological research: Part III considers global problems of societal relevance, and their corresponding research areas: Part IV contains proposals for further research on societal utilization of R & D, through international comparative studies conducted under the aegis of Unesco. There is also an extensive bibliography on the subject under study: Annex I describes the purpose and status of the Pont d'Oye Seminar, and includes a list of participants: Annex II is a synthesis of complementary - and sometimes conflicting - views expressed during the working sessions of the Pont d'Oye Seminar.

UNESCO, Science and Technology in Asian Development, UNESCO, Paris, 1970

III A report based on a conference held in New Dehli in 1968 which reviewed the application of science and technology to Asian Development. It reviews the status of the application of science and technology to development in 19 countries and then examines the social and economic prerequisites for the application of science and technology to development. This involves particular consideration of science education and the role of science policy in natural development planning. The report includes discussion of a model of manpower planning and research and development expenditures. A set of general recommendations include priorities for action and mechanisms for regional co-operation.

UNESCO, Science, technology and development in Asia and the Pacific - CASTASIA II - Analysis of trends, issues and prospects and report of the conference, UNESCO, Paris, 1983, (Science Policy Studies & Documents No. 55)

II One document in a series of Science Policy Studies. It starts with a review of science and technology in the whole region and then examines major issues of science and technology policy in the 1980's. It addresses the need to build-up indigenous scientific and technological capabilities through education and training, research and development programmes and support services. It examines the policy requirement for the integration of science and technology into development and reviews the prospects for international and regional co-operation.

Weiss, C, 'Mobilising Technology for Developing Countries', Science, Vol. 203, No.4385, 16 March 1979, American Association for the Advancement of Science, pp.1083-89

II A discussion of the need for technology policies for Developing Countries which will contribute to the creation of productive jobs and providing minimum public services at a cost and level of sophistication within the reach of poor people. The author argues that this requires that careful consideration is given to overall development objectives, as well as to those of particular industrial sectors. The fulfilment of these objectives may require innovations both in material technologies, and in social (or 'software') innovations, such as education, training and other institutions.

Zahlan, A.B., 'Science in the Arab Middle East', Minerva, Vol. VIII, No.1, Jan. 1970, 59 St. Martins Lane, London WC2N 4JJ, pp.8-35

II A review of the state of science teaching and research in the universities of the Arab states of the Middle East just a few years before OPEC raised the market price of oil and thereby transformed the basis of scientific and technological progress in the region. The paper identifies some ten major obstacles to the reform of Arab science, and it is clear that only some of them could be dealt with by devoting more money to their solutions and some indeed might be aggravated in the process.

Ziman, J., Pursuit of Knowledge: Science as a Vocation, CSIR, New Dehli, 1980, 28pp mimeograph

II A brief overview of science education and work. A discussion of the intellectual and social demands on scientists and opportunities and rewards open to them.

Section 1b: Scientists and Technologists, and their professional institutions

While Section 1a dealt with the social and economic role of scientific and technological knowledge, this section is concerned with scientific and technological personnel as individuals and as institutionalised groups. This field of enquiry is slightly more empirical and accordingly somewhat less contested than the material of the previous section. The questions which are addressed include how people come to be scientists and technologists, how they operate in their professional roles, the internal dynamics of these professional communities, as well as the interactions between the scientific and technological communities and other sections of society.

One of the basic topics of enquiry in this field is: why and how do people become scientists and technologists? This leads us to ask: why is there a system of science education, and why are there professionalised communities of scientists and technologists? It would then be appropriate to examine the beliefs, aspirations, personalities and intellectual qualities of the pupils and students, as well as their recruitment, education and training. To put it in economistic terms one is talking here about the industrial production of scientists and technologists. When we have an understanding of how and why professional scientists and technologists are produced, we might then raise questions about their utilization and employment. Professionally trained scientists and technologists, in so far as they gain employment which utilizes their formal skills, work either in privately or publically owned industries, or in government (in research, development or as civil servants), in education, or (in some cases) for international agencies.

These professionalised and institutionalised communities of scientists and technologists are themselves then objects of study. Questions are asked about the social structures and the social dynamics of these communities; and about their responsibilities and limitations. In this context people have sought to understand the mechanisms by which these groups maintain their cohesion, provide discipline, rewards and recognition, maintain quality control, and cope with internal deviance and with their interactions with other social groups. In effect, much of the work which has been done in this field is concerned either to demonstrate that the scientific community is a pure meritocracy which acts wisely and responsibly, or to argue that it is not one but should be, or thirdly to dismiss that entire idea as a romantic illusion.

The largest single body of empirical work in this field has been conducted in the United States of America. This is entirely understandable since it is the U.S.A. which has the largest single community of scientists and technologists. Much of the pioneering work on the empirical sociology of the scientific community was initiated by, and follows from, the work of Robert Merton (q.v.), and a great portion of his work was conducted during the nineteen thirties and forties. Although Merton's work was empirical this does not mean that it did not depend upon theoretical assumptions. On the contrary, it was developed quite explicitly within a functionalist framework. To a first approximation, functionalism is a framework in which the organisation and operation of the scientific community are analysed on the basis of an organic analogy. On this model it is assumed that the several organs of a body act co-operatively to the benefit of the whole, and in harmony with a stable environment. This model assumes a common overall interest, with which the parts and actions of the professional communities can be effectively integrated. If harmony is not yet achieved, this is because the different elements are not correctly disposed, for example because there

are unresolved frictions between the parts. Many people have objected that Merton presented an idealised image of the scientific community. Certainly, Merton was overly preoccupied with academic science and failed to appreciate the importance of that predominant proportion of scientists and technologists who do not work in universities. Functionalist sociology of science has been extremely influential not just in the U.S.A. but world-wide, and has become important in relation to the communities of both science and technology. Merton provided a model against which the real world of scientists, and of other groups, are judged; and by reference to which many problems are posed. For example, following Merton many people have assumed that in their formal education scientists acquire a set of norms and values of professional conduct which are entirely suited to life and work in an academic environment, but which are not necessarily appropriate to work in commercial and industrial research, or to employment as advisors in government. It has therefore been thought that scientists working in non-academic contexts will experience and endure "role strain". This set of assumptions have guided a great deal of theoretical and empirical work in the sociology of scientists and technologists.

More recently (since the mid-1960's) there has been developed a substantial post-Mertonian critique, which has been an attempt to provide a far more realistic and less idealised view of science and technology; and this work has been allied to some extent to parallel revisions in the Philosophy of Science (see e.g. the work of Kuhn). Much of this work has been accomplished in Britian where Mertonianism was never so influential (see e.g. the work of Barnes, Dolby and Ellis); but it has also come to be significant in the U.S.A. (see e.g. the work of Krohn).

One of the main motivations for the sponsorship of work on the sociology of professional scientists and technologists in the Industrialised Countries has come from those people who are charged with the management and direction of research and development. The concern of these groups, quite naturally, is with the determinants of the productivity and creativity of their research and development teams. Another approach has, however, come from those who are concerned that scientific and technological R & D has been excessively subordinated to the demands of industry, commerce and governments. These writers have sought not so much to optimise the match between the demands of industry and government and the labours of scientists and technologists, as to draw attention to the risks which arise from too close a connection between these groups. But while Merton and the many of the Mertonians argued that it should be the scientists themselves who should direct their own work, this latter group insists rather that the communities of scientists and technologists should be answerable for the results of their work to the whole community and not merely to their direct employers in industry and government.

One of the major concerns of those who have studied the communities of professionalised scientists and technologists is with their actions and responsibilities as advisors in matters of public controversy. Particular problems arise when there is serious and deep disagreement between the experts. There are important discussions about how scientists and technologists do act in situations of controversy, and how they should act; and concerning the extent to which professional judgement can be compromised by their responsibilities to their employers.

By now it should be clear that scientists and technologists in the Developing Countries are in conditions which are fundamentally different from those in the Industrialised Countries. Many of the same questions can be asked of both groups, but frequently different answers have to be provided. Furthermore, professional scientists and technologists in Developing Countries are confronted by problems and challenges not normally encountered by their colleagues in the Industrialised Countries. It is perhaps not surprising, but still a matter of regret, that the scientific and technological communities of the Developing Countries have received far less attention than those in the richer countries. Even when we are considering professional science and technology in the Industrialised Countries we have to recognise that there are innumerable gaps in our knowledge. This is even more true as regards the Developing Countries. The material which is listed below is therefore intended to provide a guide to the available work on the social and economic role of professional scientists and engineers in a wide variety of contexts, but there can be no pretence that this material provides as many answers as it does questions. Moreover, given the little which we do know, there remain numerous debates about the policy implications of these results.

Armytage, W.H.G., The Rise of the Technocrats, Routledge & Kegan Paul, 1965

III An early, and classic, text of historical scholarship on the social power of scientists. This is a wide ranging historical study which covers a period of four hundred years, but particularly examines the impact of industrialization and the crucial importance of scientific knowledge and personnel in the modern world.

Barnes, S.B. & Dolby, R.G.A., 'The Scientific Ethos: A deviant viewpoint', in Archives of European Sociology, Vol. XI, 1970, pp.3-25.

II A critical review of Robert Merton's account of the norms and values of scientific practice. The authors introduce evidence intended to show not just that scientists do not act in accordance with Merton's prescriptions, but also that they should not, and could not, do so. An argument to show that functionalist sociology cannot cope adequately with the practice of scientists.

Barnes, S.B., '"Making Out", in Industrial Research', Science Studies, Vol.1, 1971, Macmillan (Journals), London, pp.157-75

III A discussion of theories and evidence concerning the actions and values of industrial scientists. The author is critical of orthodox Mertonian functionalism which assumes that scientists acquire and internalise norms of behaviour and values during their academic training and then carry them into their subsequent industrial employment. This author argues that the data presented, and elsewhere available, supports a contrary thesis that values and norms are highly unstable and that industrial scientists, among others, discard old values once they are inappropriate or irrelevant. He argues rather that industrial recruits rapidly adopt the attitudes, values and norms of the institution which employs them.

Barnes, B. & Edge, D., Science in Context, Open University Press, 1982

II A modern collection which might well serve as a text for an undergraduate course in the sociology of science. It is intended to be an introduction to the sociology of science, scientists and scientific institutions. It consists of an editorial introduction and 18 papers divided into five sections. Part One deals with the organization of academic science, communications and control; Part Two with "The Culture of Science"; Part Three with the interaction of science and technology; Part Four with the interaction of science and society; and Part Five with science as expertise. The volume also has an up-to-date bibliography, which is not annotated, of 417 entries.

Benveniste, G, The Politics of Expertise, Glendesary Press, Berkeley, California; and Croom Helm, London, 1972

III This book shows how and why experts influence public and private policies and demonstrates the limits of technocracy. It examines in particular the role of systems experts and planners in industry and government. Their role inevitable involves giving advice on issues, and in terms, of both technical and political matters.

Blume, S., Towards a Political Sociology of Science, Free Press, New York & Collier Macmillan London, 1974

IV An attempt to provide an account of the character of the scientific community and its relations with other sectors of society which combines the perspectives of both sociology and political science. The author argues that as the political and economic pressures on the scientific community intensify, the members of that community are forced into a greater awareness of their relations with the power structure of society; while at the same time governments are becoming increasingly dependent on scientific advisors. The book focuses mainly on the USA but the issues addressed will arise in any industrial or industrialising country.

Blume, S., Perspectives in The Sociology of Science, J. Wiley & Sons, 1977

III An editor's introduction and seven diverse articles in the sociology of science. The chapters are as follows:
1. R.D. Whitley, 'The Sociology of Scientific Work and the History of Scientific Developments'
2. P. Weingart, 'Science Policy and the Development of Science'
3. E. Negman, 'Scientific Career, Scientific Generation, Scientific Labour Market'
4. L.H. Orzack, 'Competing Professions and the Public Interest in the European Economic Community: Drugs and their Quality Control'
5. M. Fournier & L. Maheu, 'Nationalisms and Nationalization of the Scientific Field in Quebec
6. R. Ramasubban, 'Towards a Relevant Sociology of Science for India'
7. S.C. Hill, 'Contrary Meanings of Science - Interaction between Cultural and Personal Meanings of Research in a Developing Country Scientific Research Institution'.

Bosworth, D.L., 'Technological Manpower', in Higher Education and the Labour Market, R. Lindley (Ed.), Society for Research into Higher Education, 1981

IV This paper deals in quantitative and economistic terms with the supply and demand for scientists and technologists in the British economy. While much of their data is not relevant to other contexts, the factors which are measured, and the framework which is introduced, are of broader relevance. What is particularly noteworthy is the contradiction which is pointed out between the number of unemployed scientists and engineers, and the complaints from British industrialists that they cannot find enough highly qualified technological manpower. A consideration of relative wage rates goes some way to explaining the apparent paradox.

Broad, W. & Wade, N., Betrayers of the Truth: Fraud and Deceit in the Halls of Science, Simon & Schuster/Touchstone, 1983

II The authors seek to show that fraud and deceit are not exceptional events in scientific practice, and that scientific method is purely a rhetorical device. They manage to show that such practices are far more wide-spread than is generally appreciated, but they do not show that it is universal or unavoidable.

Cardwell, D.S.L., The Organisation of Science in England, Heineman Educational Books, London, 1972

II By drawing primarily on British history, the author reveals the increasing importance of science education for industrialization, and the consequent impact on the scientific community on the development of professionalised science and engineering.

Cotgrove, S. & Box, S., Science, Industry and Society, Allen and Unwin, 1970

III An examination of a sample of scientists in British industry. It was designed, in part, to examine the relevance of the work of Merton, Marcson and Hagstrom (q.v.) to the British experience. The authors examined the changing roles and careers of scientists, their socialization, education and occupational choices. They cast serious doubt on claims that industrial scientists suffer from "role strain", but uncover quite different sources of professional anxiety and dissatisfaction.

Cole, J.R. & S., Social Stratification in Science, University of Chicago Press, 1973

III This study is concerned with the social structure of the scientific community and how that structure determines patterns of scientific behaviour. It provides quantitative techniques and data with which it assesses the quality of scientific research and patterns of stratification in American science. It presents a great deal of evidence for the thesis that the reception which a publication receives is a function of the location and status of the author or authors. There is an examination of discrimination against women and minorities in American science. The study reaches the conclusion that American science is almost a pure "meritocracy".

Crane, D., Invisible Colleges: Diffusion of Knowledge in Scientific Communities, University of Chicago Press, 1972

IV A classic text examining many of the formal and informal networks of communication which support the cohesion and effective operation of numerous scientific communities. The author sets out to describe and explain how scientific communities affect the growth of knowledge; she reviews numerous previous studies and reports on the results of her own empirical researches.

Dyson, F.J., Disturbing the Universe: A Life in Science, Harper & Row, New York, 1979

II The author's recollections of his work as a scientist for over fifty years. It includes his early attractions to science, his work with Bomber Command in the Second World War. He recalls his acquaintance with many major physicists; and there is a particularly fascinating account of the development of his attitudes to nuclear weapons.

Edsall, J. T., 'Two Aspects of Scientific Responsibility', Science, Vol. 212, No.4490, 3 April 1981, American Association for the Advancement of Science, pp.11-14

II The author is concerned about the thought that the pursuit of private commercial gain from novel scientific discoveries may be leading scientists to restrict the reporting and communication of their results. He is also concerned that the community of scientists should develop clear quidelines for how to behave in public controversies over technical decisions.

Ehrenreich, J. (ed.), The Cultural Crisis of Modern Medicine, Monthly Review Press, London, 1978

III Part I of this book explores the social functions of medicine from a theoretical point of view. Parts II and III are more empirical. Part III (Medicine and Imperialism) looks at how social relations between oppressor and oppressed characterise relations between doctor and patient.

Eiduson, B.T., Scientists: Their Psychological World, Basic Books, New York, 1962

II A classic document reporting the results of interviews with forty eminent research scientists. The focus is on the scientists' perceptions of their own socialization, education and professional experience. The author seeks to provide a psychological profile of her sample in the hope that it will be of more general relevance. Questions can now be asked, however, as to how representative that sample can be of scientists working currently in research, and of those in industry.

Ellis, N. D., 'The Occupation of Science', in Technology and Society, Vol. 5, No.1, 1969, New Jersey Institute of Technology, Newark, N.J. 07102, pp.33-41; rpt. in B. Barnes (Ed.), Sociology of Science, Ch. 11, pp.188-205

II A review of orthodox models of the sociology of scientists employed in government and industry, and some criticisms of the limitations of those models. Concludes with some useful data which confounds much that orthodox sociologists have said, and seems to call for a new approach.

Evan, W.M. (ed.), Knowledge and Power in a Global Society, Sage Publications, Beverley Hill & London, 1981

III This is essentially a study of the current impact and potential value of International Scientific and Professional Associations (or ISPAs). The authors assume that science is of global relevance and applicability, but that politicians in national states reach decisions by a calculus of solely national interests. These collected papers from a conference at the University of Pennsylvania, explore the potential influence of ISPAs on global problems and international decision-making. Part I reviews the objectives and activities of ISPAs. Part II, III and IV review their economic, political and social impacts respectively.

Fisch, R., 'Psychology of Science', in Science, Technology and Society, D. de Solla Price and I. Spiegel-Rosing (Eds.), (q.v.), Ch. 8

III A comprehensive review of several decades of work on the psychology of scientists. It deals with the motives, norms, values and attitudes of science students and of trained scientists. It also considers the development of careers, mobility, creativity and productivity and sex differences within the scientific community.

Gaston, J., The Reward System in British and American Science, J. Wiley & Sons, New York, 1978

III This study of British and American scientific communities examines whether the reputations of scientists can be attributed to their research productivity or to personally acquired social connections. It uses a random sample of scientists in physics, chemistry and biology and examines the way in which the social organization of research affects the operation of the reward system.

Gaston, J. (Ed.), The Sociology of Science, Jossey-Bass, London & San Francisco, 1978

III A collection of scholarly papers which provide an overview of American work in the sociology of science. It is organised into three parts. Part I reviews the extent to which the scientific community conforms in its actions to the norm of 'universalism', or whether factors such as the race or sex of scientists influence judgements. Part 2 contains two papers on the issue of how and why researchers choose their research topics. The final part of the book contains five papers intended to reflect the wide diversity of approaches to science from sociology.

Gerstl, J.E. & Hutton, S.P., Engineers: The Anatomy of a Professon: A Study of Mechanical Engineers in Britain, Tavistock Publications, London, 1966

III Rather an old book, but still one of the very few systematic and empirical studies of engineers. While the community of scientists receive relatively a lot of attention, engineers remain substantially neglected despite their importance. The results of this study may perhaps be peripheral to the concerns of Developing Countries in the 1980s, but the questions, concepts and methods which are introduced are relevant quite generally.

Gore, A., 'The Scientist as Worker', in Science and Liberation, R. Arditti et.al. (eds.), South End Press, Boston, Mass., 1980

III An attempt to question the social role of scientists, asking if they should be understood just like all other workers, or whether they have a peculiar role which implies a distinctive set of interests and allegiances. The author argues that no simple answer to the question is possible since scientists are both the beneficiaries and victims of social conflicts, and that in particular circumstances they may endure divided loyalties.

Haberer, J., Politics and the Community of Science, Van Norstrand Reinhold Co., 1969

II This is a study of the relationships between politics and the community of scientists. It is distinctive in that it approaches these matters from both a historical and cross-cultural perspective thereby hopefully indicating conclusions which are of more than local relevance. The author argues that most scientists in most contexts have judged it prudent for them to acquiesce whenever they are confronted by the demand or restrictions of the state. The author further argues that since the Second World War the interactions between politics and scientists have become so intense that responsible scientists must develop alternative strategies to cope with the pressures now on modern science. He approaches his conclusions through a historical set of case studies including the scientists in Germany during the Weimar Republic and the Nazi Period, and the American scientific community and the case of J. Robert Oppenheimer.

Haberer, J., 'Politicalization in Science', Science, Vol. 178, 17 Nov. 1972, American Association for the Advancement of Science, pp.713-724

II A critical description of three major changes which have occured in the community of science this century: firstly, the politicalization of science, then the change from an international orientation to national orientations, and the professionalization of scientists. The author also considers some of the consequences of these changes and possible responses to these new circumstances.

Hagstrom, W.O., The Scientific Community, Basic Books, 1965

II An early and classic study of the sociology of the American scientific community. It seeks to answer the following questions: who are the leaders of the community? How do they exercise their power and influence? How do scientists conform to or rebel against the power structure? How important is priority of discoveries, and how are conflicts over priority adjudicated? And, How do scientists communicate within and between disciplines?

Halmos, P. (ed.), The Sociology of Science, Sociological Review Monograph, No. 18, 1972, University of Keele, 1972

IV A collection of ten papers by eminent scholars. The essays deal both with the sociology of the scientific community, and with the sociology of scientific knowledge.

Head, J., 'Personality and the pursuit of science', Studies in Science Education, Vol. 6, 1979, Nafferton Books, pp.23-44

III This paper seeks to examine the nature of the personality variables which contribute to, or discourage, the pursuit of science education by school pupils and college students. It also considers how these crucial characteristics change and develop with time. The author reviews work done in this field and postulates that a psycho-dynamic model of personality development in adolescence might be relevant to further study.

Illich, I., et.al., Disabling Professions, Marion Boyars, 1977

II A collection of five papers which question whether professionalization of skills and services actually improves services or merely subordinates the recipients to the experts. Illich argues generally that the professions are not acting in the interests of the community as a whole. I. K. Zola argues that the medical profession has become a major instrument of social control. J. McKnight argues that the 'clients' are used to meet the needs of the professionals rather than vice versa. J. Caplan critically examines the legal profession, and H. Shaikey argues that the professionalization of industrial management has lead to the impoverishment of industrial work. Many of the questions raised generally about professionalization can be raised specifically in relation to scientists and engineers.

The Journal of Development Studies, Vo. 9. No. 1, Oct. 1972, Frank Cass, London, 'Special Issue on Science and Technology in Development'

III Ten articles by leading international authors on science and technology in production, introduced by C. Cooper.

King, M.D., 'Science and the Professional Dilemma' in J. Gould (Ed.), Penguin Social Science Survey 1968, Penguin, 1968

II The dilema referred to in the title is one which arises as scientists are increasingly subsidised by public funds and drawn into matters of public controversy. On the one hand, scientists in pursuit of professional expertise focussed their attention into a narrow field. But to deal, on the other hand, with politicians, employers, administrators and the lay public, the scientists must expand the scope of their authority. Furthermore, scientists tend to emphasize the utility of their work when they request funds, but emphasize the abstractness and autonomy of their work as they spend those funds. The author describes and criticises several ways in which scientists and sociologists of science might try to deal with these problems.

Kornhauser, W., Scientists in Industry, University of California Press, 1963

III A classic text in the Mertonian tradition which starts by assuming that there will be conflict between the academic norms and values of university trained scientists and the demands of industrial employment. It examines the goals of professional scientists in industry and the social organization of industrial research.

Krohn, R.G., 'The Scientist - A Changing Social Type', in American Behavioural Scientist, Vol. 6, 1962, No.4, SAGE, London & Beverley Hills, pp.48-51

III A report of empirical quantitative research which seems to show that scientists tend to adapt to their employing institution and to accept its norms and values, rather than carry the supposed norms and values of academic science into industry and government work. The possible role of self-selection is not, however, considered in this study.

Krohn, R.G., The Social Shaping of Science: Institutions, Ideology and Careers in Science, Greenwood Publishing Corp., Westwood, Connecticut, 1971

III A report of an empirical study which began in 1959 and examined the careers of 178 male scientists employed in universities and industry. It examines both individuals and institutions and their interactions. The author argues in particular, that scientists in whatever employment tend to share the values and aspirations of their employing institution, and that they do not always yearn for a distinctively academic environment.

Kuhn, T.S., The Structure of Scientific Revolutions, University of Chicago Press, 1970

II An immensely influential book. It is uncompromisingly interdisciplinary. It discusses a whole range of issues in the history, philosophy and sociology of the scientific community. The account which the author provides of the scientific community is generally thought to be accurate, though perhaps incomplete. There is more disagreement, however, concerning the philosophical morals which the author draws from his account of the history and sociology of science.

Lakoff, S.A. (ed.), Knowledge and Power: Essays on Science and Government, Free Press, New York & Collier-Macmillan, London, 1966

II An early, but highly authoritative set of fifteen articles on the relations between governments and the scientific community. Following an editor's introduction, the volume is in three parts; part I reviews seven cases and controversies, part II examines how public science is governed, while the final part reviews general matters of state science policy.

Latour, B. & Woolgar, S., Laboratory Life: The Social Construction of Laboratory Facts, Sage, 1979

III A rare example of participant observation upon the process of scientific research. It describes the general organization of laboratory work, how 'facts' are identified, negociated and stabilised. The authors take the view that: "Argument between scientists transforms some statements into figments of one's subjective imagination, and others into facts of nature. The constant fluctuation of statements' factuity allowed us approximately to describe the different stages in the construction of facts, as if a laboratory was a factory where facts were produced on an assembly line."

MacRae, D., 'Technical Communities and Politcal Choice', Minerva, Vol. 14, No.2, 1976, 59 St. Martins Lane, London WC2N 4JS, pp.169-90

II The author is concerned with the invention and establishment of institutions through which the practical advice of experts may be verified and refined by other experts. In addition, since these groups of experts may still propose policies which require correction on either factual or evaluative grounds, their advice must also be controlled by democratic processes. He argues that it is important not only to ensure that expert advisers are genuinely expert, but also to make the advisers responsible to the public through representative institutions. It would contribute to this if information produced by experts were very widely available and distributed.

Mahoney, M. J., Scientist As Subject: The Psychological Imperative, Ballinger Publishing Co., Massachusetts, 1976

III This book is a report of some empirical studies of academic scientists and an attempt to stimulate further work. It deals with recruitment and education of scientists, and with their subsequent professional experiences. It considers their striving to publish, and their rewards and competition in science. It also examines the empirical adequacy of some philosophical models of scientific processes; and proposes reforms to our views of science and scientists, if not to their practices.

Mahoney, M.J., 'Psychology of the Scientist: An Evaluative Review', Social Studies of Science, Vol.9., No.3, 1979, SAGE, London, pp.349-75

III This article reviews sociological, archival, and recent experimental evidence bearing on the psychology of scientists. These data suggest that the correspondence between scientific behaviour and accepted scientific 'ideals' may be far less than has been presumed. After briefly reappraising those ideals, the author argues that psychological research, and particularly psychological theorising, are critical to an adequate understanding and refinement of human factors in science.

Marcson, S., The Scientist in American Industry: Some Organizational Determinants in Manpower Utilization, Harper, New York, 1960

II This book is rooted in a concern to ensure that the American economy is making use of its research scientists for the contribution which they can make in the struggle for world leadership and "... to outdistance Soviet economic gains." The book is a report of a two year study by The Industrial Relations Section of Princeton University. The author seeks to identify optimal conditions of employment and organization to maximise the quality and quantity of American scientific productivity. He examines the management and organization of industrial laboratories, the recruitment and career development of scientists; the needs and problems of scientists and ways of responding to them.

Medawer, P.B., Advice To A Young Scientist, Harper & Row, New York and London, 1979

II This book is intended to inform, encourage and enlighten those who are considering a career in scientific research. It deals with the question of how to decide whether or not one is suited for such work, and how a student may prepare her or himself. It includes a chapter on racism and sexism in science, and includes also a great deal of advice from a successful and respected scientist on how to achieve success and respect within the scientific community.

Mendelsohn, E., 'The Emergence of Science as a Profession in Nineteenth Century Europe', in K. Hill (Ed.), The Management of Scientists, Beacon Press, Boston, 1964

II A seminal article comparing the relationship between the professionalization of scientists and industrialization in major European countries in the nineteenth century. The author shows that while Britain industrialised first, and without a professionalised community of scientists, this option was not available to any other countries in their subsequent industrialization; and by extension implying a similar moral for Developing Countries in this century.

Merton, R.K., 'Science and the Social Order', in his Social Theory and Social Structure, Free Press, New York, 1968

II One of five papers in this volume on the sociology of science, and perhaps his most influential contribution to the field. Merton argues in effect that science has a critical function to perform in combatting totalitarianism, for it embodies some of the highest values and achievements of humanity. Merton argues that properly conducted scientific work is characterised by a set of norms and values which are constituitive of the scientific community, contribute to its effective operation and to the intellectual value of its products.

Merton, R.K., The Sociology of Science: Theoretical and Empirical Investigations, edited and introduced by N.W. Storer, University of Chicago Press, 1974

III A collection of 22 papers by one of the major founders of the sociology of science. Many of the papers continue to be considered important and valuable even if Merton's functionalist approach is being increasingly questioned and rejected. Merton's account of the norms and values of the scientific community has been particularly influential, and remains a focus of debate and controversy.

Mulkay, M., The Social Process of Innovation: A Study in the Sociology of Science, Macmillan, 1972

II This is a study of the social processes within the scientific research community, and one which seeks to relate those processes to the developments of scientific knowledge. The author considers in particular the relations between intellectual innovations and conformity to the intellectual and technical norms of scientific action. The author argues that innovations frequently arise from the cross-fertilization of ideas which can occur when researchers move from one social network into others.

Mulkay, M., 'Sociology of the Scientific Research Community', in Science, Technology and Society, D. de Solla Price and I. Spiegel-Rosing (Eds.), Sage Publications, London and Beverley Hills, 1977, Ch.4

III A comprehensive review of a wide range of scholarly work on the social organization of the academic scientific community. It deals in particular with the norms of scientific work and the distribution of information, ideas and rewards, as well as with hierarchies and forms of social control in science.

NATO Science Committee, with the European Science Foundation and the United States Research Council, International Mobility of Scientists and Engineers, NATO, 1982

III Representatives of private and governmental organizations in science and technology in eighteen countries from Western Europe, North America and Japan, met in Lisbon in 1981 to discuss the mobility of scientists and engineers among the industrialised countries. The workshop arose out of a concern that there was too little international movement and collaboration. The participants explored a variety of possible policy initiatives which they hope might contribute to increased mobilities which included tax incentives, work permits, sabbatical, and promotion system. There was no discussion of mobility between the Industrialised Countries and the Developing Countries.

Noble, D., America By Design: Science, Technology and the Rise of Corporate Capitalism, Oxford University Press, 1977, £6.95

II A detailed historical account of the role of scientific and technological personnel and institutions in the development of U.S. industry from 1880 to 1930. Within a neo-Marxist framework, Noble describes the rise of science-based industries, the development of technical education, and the professionalization of engineering; and he accounts for these developments by reference to explicit corporate policies.

Noble, D., 'Corporate Roots of American Science', in Science and Liberation, R. Arditti et.al. (Eds.), South End Press, Boston, Massachusetts, 1980

II An account of the role of U.S. industrial corporations in forming the institutions, policies and practices of American science and technology education. The particular example provided is the Massachusetts Institute of Technology, but the claim is that this is a typical example of the American experience. The author further argues that students are trained to accept and not to question the goals and practices of the industrial corporations or their work in them.

Organisation for Economic Co-operation and Development, The International Movements of Scientists and Engineers, OECD Paris, 1969, Document No. STP(69)3.

IV An empirical and quantitative study of the movement of scientists and engineers within and between the OECD countries. It concentrates particularly on flows of personnel to North America, but does not explore flows to and from Developing Countries.

Pelz, D.C. & Andrews, F.M., Scientists in Organizations: Productive Climates for Research and Development, J. Wiley & Sons, New York, 1966

IV A classic text, which was an early attempt to delineate the optimal conditions for productive work by scientists in research and development. The book reports the results of empirical studies of 1300 members of staff in a range of organizations in industry, government and universities in the USA. The report deals with: freedom, communication, diversity, dedication, motivations, satisfactions, similarily, creativity, age, co-ordination and group performance.

Price, D.K., The Scientific Estate, Oxford University Press, 1965

III An attempt to provide the scientific community of the United States in the 1960's with an account of the politics of science and with an understanding of the problems of the organisation of science and science policy. Obviously the focus is specific to the U.S. at that time, but the author addresses issues concerning the relations of scientists to governments which are relevant far more widely.

Rahman, A., 'Scientists in India: the impact of economic policies and support in historical and social perspective', in International Social Science Journal, 1970, Vol. 22, No. 1, Paris, UNESCO, pp.54-79

III An empirical study of the Indian scientific community located in a general theoretical debate about the sociology of scientists in Developing Countries. It presents data on: Indian government science policies, education and research and development expenditures, relations between research and development and industry; as well as statistics on employment, unemployment, age and salaries of Indian scientists. There is also a consideration of institutional organization and international relations.

Ravetz, J.R., Scientific Knowledge and Its Social Problems, Penguin Books, 1973

II This comprehensive study starts from an examination of the varieties of experience in scientific work, then reviews the nature of scientific knowledge and the ways in which it may be generated. Next it discusses some of the ways in which the institutionalized scientific community functions socially, for example to protect property, manage novelty and sustain quality. The book concludes with a wide ranging review of social, ethical and political problems associated with the generation and application of scientific knowledge.

Richter, M. N., Science as a Cultural Process, Schenkman Publishing Co. Inc., Massachusetts, 1972

III An essay by a sociologist in which he reviews science as a social practice. It is not a report of an empirical study of some specific group, but a theoretical discussion of the social meaning of science. The author reviews several sociological approaches to science for example as a method, an institution, an occupation and a profession, but argues that it is all of these and more, and needs to be conceived as a cultural process. This cultural process is then seen as having both constant characteristics through time and space, and some changing and developing characteristics. It is curious, given some of the discussion, that the author concludes, in part, that the course of the development of science is independent of social forces.

Robbins, D. & Johnston, R., 'The Role of Cognitive and Occupational Differentiation in Scientific Controversies', Social Studies of Science, Vol. 6, 1976, SAGE, London, pp.349-68

II This is an attempt to account for conflicts of opinions between scientific experts, and groups of experts, on matters of public controversy. By reference to three issues, namely those concerning levels of lead in the environment, low-level nuclear radiation and the anti-ballistic missile system, the authors show that conflict between various groups of scientific experts can be related to cognitive and occupational differences between groups, that is, to differences in technical and cognitive standards and norms of different sets of scientists.

Roe, A., The Making of a Scientist, Dodd, Mead & Co., New York, 1953

III An old but classic text on the psychology of scientists. A report of a study of 64 eminent scientists from both the natural and social scientists. The sample was then small and unrepresentative, and is now out of date, but some of the results remain valid. Roe reports that professional scientists are predominently male, and were either an only child, or did not have a close sibling. They experienced above average difficulty in developing friendships, particularly with women, and tended to be more comfortable with "things" rather than people. They felt more comfortable and confident in their work than at home.

Rose, H. & Rose, S., Science and Society, Pelican, 1983

II A text intended for use by college students, but also valuable for the general reader. It describes the historical development of the profession of science and its interaction with politics, war, industry and commerce. The first six chapters focus primarily on the British experience, but then expands to a consideration of Western Europe, and then the super-powers and the Third World.

The Royal Society, The Social Responsibility of Scientists, The Royal Society, 1980

II The proceedings of a joint meeting of the Royal Society of London and the American Philosophical Society on the responsibilities of modern scientists. It includes three papers, plus an introduction and a record of the subsequent discussion.

Saks, M. 'Removing the blinkers?' A Critique of recent contributions to the sociology of professions', The Sociological Review, Feb. 1983, Vol. 31, No.1, Routledge & Kegan Paul, pp.1-19

III A critical review of a wide range of work on the social role of professionals. The author uses three main categories into which he divides recent sociological work: the taxonomic, the neo-Weberian and the Marxist. He finds some strengths and several weaknesses in each of these schools of thought, and proposes a new approach to the study of this field. Although the paper discusses professionals quite generally, it does identify distinctive approaches each of which have been applied to the study of scientists.

Schwartz, 'Scholars for Dollars', in Science and Liberation, R. Arditti et.al. (Eds.), South End Press, Boston, Mass., 1980

II An account of the close relationship between American industry, the U.S. military and the heads of the major institutions of science and technology education, with some empirical data from a range of institutions and some proposals action to detach science and technology education from some commercial and military activities.

Schwartzman, S., 'Struggling to be Born: The Scientific Community in Brazil', Minerva, Vol.XVI, No.4, 1978, 59 St. Martins Lane, London WC2N 4JS, pp.545-580

II A historical review of the development of science and technology and scientific and technological education in Brazil from the Portuguese occupation until the 1970's. It details the colonial and positivistic influences on Brazilian science, the early scientific institutions, the development of applied research, the development of science education and the Universidade de Sao Paulo. It also details major developments since the Second World War up to the establishment of research in atomic physics, and the creation and institution of a Brazilian Science Policy. It concludes with a discussion of the role of science and technology in economic development, and the current dilemmas of science policy.

Shiva, V. & Bandyopadhyay, J. 'The Large and Fragile Community of Scientists in India', Minerva, Vol. XVIII, No. 4, 1980, 59 St. Martins Lane, London WC2N 4JS, pp.575-594

II It is estimated that in 1950 India had 188,000 scientists and that in 1983, had approximately 2,465,000 scientists. This means that India has the third largest scientific community in the world. Nonetheless, the community of Indian scientists is beset with problems including those of resource, provisions, lack of cohesion, relevance and application. The author reviews some of the problems and briefly seeks to identify some of the difficulties which require resolution.

Skoie, H. (ed.), Scientific Expertise and the Public, Institute for Studies in Research and Higher Education, Oslo, 1979

III A report of the proceedings of a conference in Oslo in June 1979. Eleven papers on five topics examined what kind of expertise was involved and the ways in which the involvement took place, and the direct and indirect consequences of the intervention of experts. The topics covered include nuclear power and asbestos dust controversies.

de Solla Price, D., Little Science, Big Science, Columbia University Press, 1973

II An attempt to examine scientific work by using the methods of science itself. It involves quantification and measurement, generalizations and the search for empirical and explanatory laws. The author has attempted to develop a calculus of scientific manpower, literature, talent and expenditure on a national and an international scale. He charts the explosive growth of scientific activities, and its consequences for the organization of the scientific community. He concludes with a discussion of political strategies appropriate for scientists in this new large scale environment.

Storer, N., The Social System of Science, Holt, Rinehart & Winston, New York, 1966

II A book which effectively synthesised a wide variety of work on the sociology of the American scientific community. It deals with professionalization and the meaning of professionalism; with scientific creativity, the norms of scientific practice and with the changing character of scientific work. A useful summary and review of orthodox material but not a challenge to current thinking.

Strickland, D.A., Scientists in Politcs: The Atomic Scientists Movement 1945-46, Purdue University, 1968

II This study of American scientists' first response to the use of atomic weapons is based on published sources, on documents of the period and interviews with some 200 scientists involved in the Atomic Scientists Movement in the United States in the period immediately after the defeat of Japan by the U.S.A. The Scientists' Movement consisted of reactions against President Truman's Atomic Energy Bill by the scientists who produced American atomic bombs; and an attempted mobilization of the entire scientific community and many liberal groups behind an alternative Atomic Energy Bill. To that date it had been the scientists' most intense involvement in public politics. This study reveals the factionalism, conflict, ideological divisions and misapprehensions within the movement.

Svatez, G.M., 'The Social Organization of a University Laboratory', Minerva, Vol.8, No.1, 1970, 59 St. Martins Lane, London WC2N 4JS, pp.36-58

III An examination of the organization of scientific work in large scale laboratories engaged in basic research. The author presents research as an industrial process and draws on examples from high energy nuclear physics. He reviews the deployment of human and national resources and then describes the development of instrumentation, the choice of experiments, data collection, reduction, analysis and publication and concludes with a brief discussion of the consequences of the industrialization of basic research.

Teich, A.H. (Ed.), Scientists and Public Affairs, MIT Press, 1974

III It is assumed that policy makers and those who implement public policies should have access to, and be able to utilize, relevant scientific and technological knowledge. And that they should have access to appropriate knowledge not just in the event of crises, but in advance of crises. It is also generally agreed that in practice these desirable states of affairs do not obtain. The essays collected in this volume seek to explain why this is the case, and how improvements might be achieved. One assumption common to the contributions is that the perceptions of policicians as to the power which knowledge may bring them is crucial. The discussion centres on the United States of America and the Soviet Union but the implications of the discussion are of wider validity.

Taton, R. 'Emergence and Development of some National Scientific Communities in the Nineteenth Century', International Social Science Journal, Vol.22, No.1, 1970, Paris, UNESCO, pp.94-110

II By reference to four examples, namely France, Germany, the United Kingdom and Japan, the author seeks to identify some essential conditions for, and obstacles to, the establishment of a thriving national professional community of scientists, in the hope that this might serve as a guide to policy makers in Developing Countries.

Taylor, C.W. & Barron, F., Scientific Creativity: Its Recognition and Development, John Wiley & Sons Inc., New York, 1963

III A collection of 31 articles from conferences at the University of Utah on The Identification of Scientific Talent. The articles deal with both theories and data on the creativity of scientists. In particular, the contributors seek to define, identify and measure creativity and to determine the educational and environmental conditions for the promotion of creativity.

UNCTAD, Case Studies in Reverse Transfer of Technology (Brain Drain): A Survey of Problems and Policies in Sri Lanka, United Nations Conference on Trade and Development, December 1977, Document No. TD/B/C.6/AC.4/4

III A study prepared by the Marga Institute in Colombo of the movement of trained scientific and technological personnel out from this Developing Country. The study seeks to quantify and explain the problem and it reviews past policies intended to deal with the problem, and proposes some alternative measures.

van Tassel, D.D., & Hall, M.G. (eds.), Science and Society in the United States, The Dorsey Press, Homewood, Illinois, 1966

III This volume is intended to provide an introduction to the ways in which modern science is interwoven into the political, economic and social institutions of the U.S.A. Following an editors' introduction, there are chapters on American science in industry, agriculture, medicine, social thought, higher education and in private and governmental agencies. Finally there is a chapter on science and the military.

Verhoog, H., 'The Responsibilities of Scientists', Minerva, Vol.19, No.4, Winter 1981, 59 St. Martins Lane, London WC2N 4JS, pp.582-604

II The author is concerned with the responsiblities which scientists have, not for scientific knowledge as such but for the cultural, political and economic structures of his own, and other societies. He identifies three stages in the institutionalization of science and seeks to specify the different responsibilities of scientists at each stage. He further distinguishes three currents of opinion concerning the responsibilities of scientists, and these he terms 'neutrality of science', 'scientism' and the 'critical--interactionist' views. The author seeks an account of the responsibilities of scientists which contributes to the realization of democracy and justice.

R. Whitley (Ed.), Social Processes of Scientific Development, Routledge & Kegan Paul, London, 1974

III A collection of 14 papers presented to a conference of the International Sociological Association's Research Committee of the British Sociological Association held in London in 1972. Following the publication of T.S. Kuhn's The Structure of Scientific Revolutions in 1962, professional sociologists re-examined their approaches to science, and concluded that they could usefully examine: "the content of science, the development of that content, the different modes of development of different sciences and the connections between scientific developments and cultural and institutional factors" (p.1). This volume reports the results of such work and it contains some excellent examples of good sociology of science.

Williams, R., Politics and Technology, Macmillan, 1971

II The author discusses the various theories which deal with the political significance of modern technology. He is concerned with the general impact of technology on political systems rather than with specific matters of public administration, or international affairs. The author examines the nature of an industrial society, and then reviews possible political imperatives of technological innovations. The twin ideas of a 'technocomplex', and a 'technostructure' are examined and there is a critical discussion of various proposals concerning possible 'post-industrial' societies.

Znaniecki, F., The Social Role of the Man of Knowledge, Columbia University Press, 1940, rpt. Octagon Books, New York, 1965

II An old book but a classic text on the social role of scientists and technologists. This is essentially a theoretical work with a long-scale historical perspective and it does not start from, but concludes with, the importance of technical knowledge in the modern world.

Section 2:
Science and technology education

Since this bibliography is focussed on science and technology education, Section 2 is obviously the heart of the bibliography, since it is directly concerned with the central topic. It might be useful to think of Section 1 as providing an economic and social context to a consideration of science and technology education, and to think of Sections 3 to 5 as dealing with its possible content. From this point of view, we can say that this section is concerned with the provision of science and technology education. Section 2a includes material which considers why and how it is to be provided. Section 2b is addressed to the question concerning what it should consist of, while Section 2c considers to whom it should be provided.

Educational institutions, and particularly schools, play a pivotal and controversial role in the lives of developing societies. A great deal is expected of them, but a great deal of support is not always provided for them. In a few cases people argue that some of the problems of society are caused by inadequacies in the educational system, but more often the school and college system is not even thought to be responsible. For example, the geographic boundaries and social composition of Developing Countries were usually determined by the outcome of imperial and colonial exploration, exploitation amd military campaigns. The borders of most nation states do not reflect the more simple divisions of geography or culture. As a result, many Developing Countries contain highly diverse culture and language groups, and communities inhabiting very different kinds of environments. It is difficult for such countries to avoid inter-communal or tribal conflicts unless they can establish a collective national identity throughout the state. Education is frequently called upon to provide that unifying national identity. Within the schooling system, science and technology education are considered to be particularly useful for this purpose. Science is generally thought of as a universal theory and account of the natural world which, if true for anyone, is true for everyone. It is held to transcend racial, cultural, tribal, religious and other social barriers. For this reason it has potentially a valuable contribution to make to unite groups of people who traditionally described and theorised the natural world in quite different ways. Moreover, since technology plays such a crucial role in establishing a modern industrial economy, technology education can also perhaps contribute to the creation of a modern society which will hopefully overcome some of the more traditional social divisions.

There are, of course, other ways in which science and technology education are important to a Developing Country. The introductions to Sections 1 and 1a have already explained that it is economically and socially vital for a community in a Developing Country to be able to provide its own resources in scientific and technological personnel and knowledge. Some of the more detailed issues which arise in relation to the provision of science and technology education will be dealt with in the specific introductions to Sections 2a, 2b and 2c.

The general introduction to Section 2 has already explained some of the reasons for the importance of science and technology education to the creation of a national identity for Developing Countries, and previous comments have contributed to an explanation of the importance of such education to the goals of economic development. There are, however, further reasons why the teaching of science and technology may be considered especially important for Developing Countries. Discussions of the creation of a national identity, and the needs of industry, commerce and employment may serve to highlight the value of scientific and technological education to the state, but it is also worth considering the value of these activities to the pupils and communities which are the recipients of the schooling. The personal development of young people may well benefit from an education which enables them to understand the changing world in which they are living, but it is also important to recognise the gulf that this education may create between school pupils and previous generations who have not had the benefits of this education.

A Developing Country which recognises the need to establish a modern and effective educational system is still faced with the problem of deciding the extent of the resources which it can devote to education, and within that overall budget it is necessary to determine the distribution of that budget between different subjects, and different groups of pupils. Some would argue that priority should be given to those in rural areas, or to girls and women, or to other relatively deprived groups, whereas others contend that the requirements of national unity and harmony imply that precisely the same provisions should be made for all groups irrespective of their prevailing social or economic positions. Aside from these questions, the schooling systems of Developing Countries, just as in the Industrialised Countries, are faced with the questions of the kinds of relations which they should seek to establish between their institutions of education and the other institutions in their society, such as industry, commerce and the government.

There is a whole set of problems concerning the relationship between the science and technology education to be provided in a Developing Country and that which is typically available in the Industrialised Countries. Most Industrialised Countries have had institutionalised educational systems for approximately one hundred years. As a result they have fully established systems for providing textbooks, laboratory equipment and other educational facilities, as well as a desire to export these products to markets in the Third World. This can pose problems for Developing Countries. In a country with many indigenous languages, national unity is sometimes pursued by using the language of the former colonial power as a lingua franca, or common linguistic medium, between the numerous native language groups. This may have several advantages. It may already be used by most if not all people, and may enable people of different cultural groups to communicate together. It may also facilitate the use of textbooks and other teaching materials which are already available in that European language, but this may be a mixed blessing. On the one hand it may be a benefit just because the materials are available, although the cost to the Developing Country is likely to be a significant factor. On the other hand the reliance on the teaching materials of the former colonial power may contribute to sustaining or intensifying dependency on that power which the educational system may be intended to diminish. Problems of the appropriateness and relevance of the educational materials to local conditions may also occur.

It would be a mistake to assume that the curriculum in science and technology education in the Industrialised Countries is uniformly appropriate and relevant to the needs and conditions of those countries. But, the evidence is that in any case, those curricula are inevitably less relevant or appropriate to the conditions and needs of Developing Countries. This means that in most cases Developing Countries have to develop their own syllabus and curriculum, and consequently they cannot simply rely on the textbooks and teaching materials of the Industrialised Countries even if their schooling utilises a European language.

This problem leads directly on to the issue of the relationships between the educational institutions of Developing Countries and international aid agencies which seek to contribute to enhancing educational provisions. UNESCO has perhaps a paradoxical role in assisting moves towards self-reliance, so seeking to assist Developing Countries to reach a stage at which they no longer require any assistance.

The educational institutions of most Developing Countries were originally established during the colonial era and either by colonial governments or by missionary organisations. In may cases, therefore, those institutions were modelled on the pattern of education which prevailed in the Industrialised Countries. This too has caused problems. Within the Industrialised Countries themselves one frequently encounters the argument that their school systems are too closely tied to generating good results in public examinations and that this can run counter to the attainment of genuine educational obejctives. If anything, this appears to be even more of a problem in the Developing Countries. It is all too easy to gear a school programme to prepare pupils for public examinations without giving sufficient consideration to the question of whether that schooling really does suit the needs and conditions of the pupils and their communities. This is, furthermore, complicated by the fact that examination qualifications are more closely connected with urban employment that with the needs of a rural economy. This means that an education system which is too closely tied to the attainment of good results in public examinations is likely to exacerbate such disequilibrium as there may be between urban and rural communities.

Almost all of the material collected in this section is by authors who are aware of these numerous and complex probelms, and are addressed to the question of how these problems may be solved.

It is worth pointing out at this stage that most of the discussion deals explicitly with science education and only occasionally refers to technology education. The relative scarcity of material on technology in this section of the bibliography is a reflection of a real scarcity in the literature. Part of the explanation for this is that technology is rarely a subject which is taught in schools. Generally speaking technology training is available only to those who have first mastered the rudiments of school science, and it tends to be taught either in institutions of further and higher education, or in industrial apprenticeships.

Adams, D. (ed.), Education in National Development, Routledge & Kegan Paul, London, 1971

III A set of eleven papers including an editor's introduction. The papers in this volume cover a wide range of topics, but they include the role of education in national integration, in the pursuit of social equalization and equilibrium and in economic and industrial development. There is also critical discussion of many assumptions which have hitherto provided educational policies for Developing Countries.

Adey, P.S., 'Adapting a School Syllabus to Local Needs', Education in Chemistry, Vol.7, No.3, 1970, The Chemical Society, Burlington House, London W1V OBN, pp.106-107

II Teachers have no need to complain of the restrictions imposed by examination syllabuses for they can rewrite them to suit their own particular conditions. In Barbados, the O-level chemistry syllabus has been revised to make the content more relevant to local conditions and to give teachers greater flexibility in their teaching method.

Anderson, C.A. & Bowman, M.J. (eds.), Education and Economic Development, Frank Cass & Co. Ltd., London, 1966

III A set of 22 papers arranged into four sections and based on a conference on The Role of Education in the Early Stages of Development, held in Chicago. The first section deals with education as an investment, and with views of "shortages". The second group of papers examine the formation of human competencies. The third deals with the diffusion of schooling, technologies and educational opportunities, while the final section deals with the human preconditions for, the timing and the pace of, change.

Arrayed, J.E., A Critical Analysis of School Science Teaching in Arab Countries, Longman; Librairie du Liban, 1980

II A comprehensive review of science teaching in the Arab countries. It provides a description of current educational practices, a critical review of efforts to improve the quality of science education and a case-study of Bahrain.

Beeby, C.E., The Quality of Education in Developing Countries, Harvard University Press, Cambirdge, Massachusetts, 1980

II This book is a response to the work by economists who have examined the economics of educational investment in Developing Countries. The author plausibly argues that economists and their methods are best able to consider the quantity of education in any state or region, but that they are less able to assess the quality of education. The author therefore seeks to fill this gap. He develops an account of quality in education and seeks to show how it can be integrated into considerations of educational policy.

Bowles, S., 'Capitalist Development and Educational Structure', World Development, Vol.6, 1978, pp.783-796, Pergamon Press Ltd.

II The author examines theoretically the relationship between educational and economic developments in the market economies of Developing Countries. He argues that the school system may serve the interests of a capitalist class by controlling the flow of workers between the market and non-market sectors, by raising the productivity of labour in the market sector, by restricting the development of either a proletariat consciousness or of a peasant-worker alliance, and by undermining the ideological position of pre-industrial ruling elites. Some empirical evidence is provided which is consistent with these claims.

Commonwealth Secretariat, Education in Rural Areas, Commonwealth Secretariat, Marlborough House, London SW1, 1970

III This is a report of a Commonwealth Conference on Education in Rural Areas which was held in Accra, Ghana in 1970. The volume is divided into three parts. The first, prepared by the Secretariat provides an informed overview of education in rural areas, and an examination of both the aims and objectives of formal schools, and of out-of-school education and training for young people, as well as a discussion of adult education and education and training for agricultural development. The second part contains seven papers by leading speakers, and Part III contains a selection of six of the major conference documents.

Coombs, P.H. & Ahmed, M., Attacking Rural Poverty: How Nonformal Education Can Help, John Hopkins University Press, Baltimore, U.S.A., 1974

IV The authors of this study are leading members of the International Council for Educational Development (ICED) and this study was funded by the World Bank and the Ford Foundation. The study was intended to generate practical guidelines for those involved in planning, implementing and evaluating programmes of non-formal education for rural development. It considers how to diagnose the educational needs of a rural community, how to select an educational delivery system, how to estimate the costs and resources required, how to develop innovative solutions, and how to evaluate the resultant programmes.

Cresswell, D., 'The Changing Function of Science Education', School Science Review, Vol. 54, No. 188, March 1973, pp.584-7

II The author provides arguments in favour of enriching the school science curriculum to include an examination of the social and political aspects of science. This can be especially important as it enables pupils to recognise that careers in science and technology are socially relevant and that they contribute to the development of society.

Curle, A., Education for Liberation, John Wiley & Sons Inc., New York, 1973

II Inspired by global social goals of harmony, liberation and human fulfilment, the author examines the extent to which education can contribute to, or militate against, human liberation. The author reviews the problems and potential of education on a large scale, but includes a particularly thoughtful chapter on education and development in poor countries.

Dore, R., 'The Educational Rat-Race in the Third World', New Society, 30th May 1974, Vol.28, No.608, pp.502-3

II The author argues that Developing Countries should shun the idea of 'de-schooling' made fashionable by Ivan Illych and others, but rather be provided with the opportunity to perform their responsibilities correctly.

Dore, R., 'The Future of Formal Education in Developing Countries', International Development Review, Vol. 17, No.2, 1975, pp.7-11

II In this brief but powerful paper the author distinguishes education from schooling and argues that much modern schooling is anti-educational. He says that education has become a ritualistic qualification-earning process, that it is often tedious, anxiety--producing and destructive of curiosity and imagination. Furthermore he argues that in most Developing Countries the schooling system is only an inept servant of the modern sector rather than an effective tool for development.

Fafunwa, B.A., 'Education in the Mother-Tongue: A Nigerian Experiment - The Six Year (Yoruba Medium) Primary Education Project at the University of Ife, Nigeria', West African Journal of Education, Vol. 19, No.7, 1975, pp. 213-227

II An account of the experiment involving the teaching of primary school pupils in their mother tongue rather than in English.

Garrett, R.M. (ed.), North-South Debate: The Educational Implications of the Brandt Report, NFER-Nelson Publishing Co. Ltd., 1981

III This document is a report of the proceedings of a conference held at Bristol, England, in January 1981. It is organised into four main parts, plus an editor's introduction and appendices. Part I contains the six plenary lectures. Part II contains the papers of six working parties, while Part III has the corresponding reports of those working parties. Part IV consists of a summary and conclusions.

Gillon, P. & Gillon, H., Science and Education in Developing Countries, Praeger Publishers, New York, 1971

III This volume contains the proceedings of the Fifth Rehovot Conference. It contains 30 papers, with a record of the discussions and the reports of the various workshops. Apart from the summary and conclusion it has six main sections. Part I reviews the aims of science education, Part II surveys science education in the Developing Countries. Part III examines children's needs and their opportunities for learning. Part IV examines technoiogical, vocational and out-of-school education. Part V considers Scientists and Teachers, while Part VI discusses new methods for new needs.

Good, R.G., How Children Learn Science: Conceptual Development and Implications for Teaching, Macmillan Publishing Co., New York, 1977

II Essentially, this is a text in applied developmental psychology. It seeks to identify many of the basic concepts in science and mathematics and examines the mental structures which must be developed as the pupil acquires and utilizes the concepts. The author then endeavours to identify the implications of the analysis for science teaching and curriculum development.

Greenough, R., Africa Prospect: Progress in Education, UNESCO, Paris, 1966

II An early, but important, text on the prospects for education and development in Africa. By reference to a handful of representative examples, the author examines many of the primary goals for African education and identifies many of the problems. While much progress has been achieved in the intervening years, some of the goals and proposals remain to be attained.

Hon-Chan, C., Education and Nation - Building in Plural Societies: The West Malaysian Experience, The Australian National University, Canberra, 1977.

III West Malaysia emerged from the post-colonial era and was faced with the formidable task of creating a nation out of numerous distinct ethnic groups. Education was seen as the primary instrument for national integration and the introduction of Bahasa Malaysia as the official language to replace English played a central role in the educational process. This volume describes the educational policies and experiences of West Malaysia, and seeks to reach conclusions which may be generally relevant to pluralistic Developing Countries.

Hunter, G., Manpower, Employment and Education on the Rural Economy of Tanzania, International Institute for Educational Planning, UNESCO, Paris, 1966

II This document is a report of a case study of education and employment in Tanzania completed at a time when most of the population had received little or no formal education. It is concerned with ensuring that optimal use is made of the prevailing level of investment in primary education, and more generally with the pressing need to use education not just to fill jobs but rather to help to create them.

Huq., M.S., Education and Development Strategy in South and South-East Asia, East-West Centre Press, Honolulu, 1965

III A thorough but slightly out-of-date examination of the role in education in the social and economic development in Indonesia, the Philippines and the Indo-Pakistan sub-continent. The author carefully explores the economic value of educational expenditure as an investment. He then considers the extent to which educational requirements are catered for in the national development plans of the countries under consideration. Many changes have occured since the publication of this volume, but not all the problems which where identified have been solved.

Jevons, F.R., The Teaching of Science: Education, Science and Society, Allen & Unwin, London, 1969

II This is an early but important attempt to consider the social value of science education. The author starts with the crucial question: Why teach Science? To this he provides a range of answers and from that discussion proceeds to a consideration of what should be taught, and how.

Kelly, P.J. & Schaefer, G., Biology Education for Community Development, Taylor & Francis, London 1980

II Many of the problems which confront Developing Countries, including food, health care, population and pollution, are biological as well as social problems. If these problems are to be effectively tackled communities require biology education which relates the topics that are taught to local conditions and needs. This volume contains papers from a wide range of contexts which have addressed themselves to these issues.

Lowe, J., Grant, N. & Williams, T.D. (eds.), Education and Nation-Building in The Third World, Scottish Academic Press, Edinburgh, 1971

III This volume is based on the proceedings of a conference and the eleven essays fall into four groups. Firstly there is a critical examination of the scope and rationale of international educational aid programmes, then there is some discussion of the relationship between economic planning and education, followed by a consideration of the social and political support for, and demands on, education. Specific attention is given to adult education, the education of women, and the language problem. In conclusion, two chapters contrast Cuban and African educational strategies and the relevance of the Soviet experience to Developing Countries.

Lucas, A.M., 'Scientific Literacy and Informal Learning', Studies in Science Education, 1983, Vol. 10, pp. 1-36

II By reference to the British context this article examines the value of adult scientific literacy and the potential contribution to it of informal learning. It reviews the sources of informal learning and its interaction with formal school study.

McFadden, C.P. (ed.), World Trends in Science Education, Atlantic Institute of Education, Halifax, Nova Scotia, Canada, 1980

III A Symposium on World Trends in Science Education was held at the Atlantic Institute in 1979 and this volume contains all the papers and discussions of that symposium.

Makulu, H.F., Education, Development and Nation-Building in Independent Africa, SCM Press Ltd., 1971

II This book, which is based on a review of international conferences, seminars and other recent studies, seeks to identify the part which education can play in the process of nation building. It draws on countries in Africa south of the Sahara but excluding the Republic of South Africa. It reviews the history of the development of African education, and current educational practices. It reaches a set of conclusions which are relevant to policy and to practice. In particular the need for curriculum reform is emphasised.

Maybury, R.H., Technical Assistance and Innovation in Science Education, John Wiley & Sons, 1975

III This study examines programmes for improving science teaching in the schools of Argentina, Brazil, Lebanon, the Philippines and Turkey. The first part presents five case-histories, with descriptive and uninterpreted accounts. The second compares and analyses the experiences of these programmes in a search for the lessons they provide on innovating in science education and on meeting the technical assistance needs that arise in that innovation.

Nelkin, D., 'Science and Technology Policy and the Democratic Process', Studies in Science Education, 1982, Vol.9., pp. 47-64, Centre for Studies in Science Education, University of Leeds

II The authoress has written extensively on public participation in the determination of science and technology policies. In this paper she discusses the requirements which such participation make upon the content of school science education, particularly in regard to changing attitudes towards expertise as a source of political legitimacy.

Odhiambo, T.R., 'The Planning and Teaching of Science According to National Needs', Impact of Science On Society, Vol. 23, No.2, April-June, 1973, pp. 95-100

II An account of some of the reasons why African countries do not yet possess a modern scientific and technological base to their economies; followed by various options which countries might now pursue to overcome their problems. The author describes a method for identifying priorities for innovation, education and research which might assist African nations to develop a strategy for science as a basis for economic development.

Open University - Faculty of Educational Studies - E563, Society, Education and the State: Block 2: Education and National Development: Units 5-7, The Open University Press, 1981

II A student text, which contains three units of Block 2 of the third level course in Educational Studies. These are: Unit 5 - Education and Development; Unit 6 - Educational Systems in an International Context, and Unit 7 - Education and Production in Socialist Countries. Units 5 & 6 should be particularly relevant in this context. Unit 5 reviews the range of ideas which are influential in relation to education and development and takes the experience of Portugal between 1930 and 1980 as a main example. Unit 6 considers education systems in an international context from a sociological and policy point of view. In this Unit, the emphasis on the international dimension is intended to supplement rather than to replace intra-state analyses.

Ozoro, O., 'Introducing Technology into Nigerian Secondary Schools: The Philosophy, Objectives and Pattern', West African Journal of Education, Vol. 16, No.2, 1973, pp. 241-251

II An account of why it is desirable to include technology education into the secondary school curriculum in Nigeria, and a description of how it might be accomplished.

Parkinson, N. (ed.), Educational Aid and National Development: An International Comparison of the Past and Recommendations for the Future, Macmillan, London, 19'6

III A comparative review of the educational aid policies of international agencies, and some of the industrialised countries, followed by specific discussions of the impact of such aid on Kenya, Senegal, Tunisia, India, Turkey and Chile. The book concludes with a general discussion of many of the issues raised and a set of recommendations for seeking to ensure that educational aid has an optimal impact on social and economic development.

Simmons, J.L., 'Technology and Education for Economic Development', in Nader, C. & Zahlen, A.B., Sciences and Technology in Developing Countries, Cambridge University Press, 1969, pp. 41-60

II An early but influential discussion of the significance of technology and hence technological education for economic development. The author seeks to establish criteria by which to identify suitable technologies for development and to examine the implied demands upon the educational system of Developing Countries.

Stevens, P., 'Problems of Learning and Teaching Science Through a Foreign Language', Studies in Science Education, Vol. 3, 1976, pp. 55-68

II An account of some of the problems concerning language encountered by English speaking teachers of science in Developing Countries.

Storer, N.W. 'The Internationality of Science and the Nationality of Scientists', International Social Science Journal, Vol. 22, No.1, 1970, pp. 80-93

II From within a Mertonian framework (see section Ib), the author seeks to develop an account of the tension within a scientist's outlook between a universal international concern and an interest in specifically national interests. He seeks to show that these tensions can be reconciled, and explores some necessary conditions for the development of self-sustaining national scientific communities.

Taylor, C.S. et.al., 'Science and Technology: the Importance of Education and Training', Science Teacher, Vol. 27, Nos. 3-4, 1979

II A straightforward explanation of the argument that technology transfer can only contribute to development if the country which receives the technology has its own resources of scientifically and technologically trained personnel.

Thring, M.W. (ed.), Applied Science for the 21st Century, Proceedings of the Society for Social Responsibility in Science, Queen Mary College, London, 1976

III Conference papers covered five main sectors: food and agriculture; medicine, medical enginnering, social services, health and homes; education, communication and recreation; energy and transport; industrial production. The conference was directed at considering the possibility for all humanity to have a decent life in the 21st century, what would be the necessary and sufficient conditions that must be fulfilled so that humans can live in a satisfactory equilibrium with their environment. The papers are interesting in being located in an enginnering context and take broad global perspecfives.

Thompson, A.R., Education and Development in Africa, Macmillan, London, 1981

II This book is organised into four parts. Part I reviews patterns of social changesd in African countries and patterns of development and considers the impact of these changes of education and how education might promote particular types of development. Part II provides a more detailed and critical assessment of some influential ideas about education and development, and argues particularly that too much is expected of the school systems. Part III considers problems of reforming education systems to meet development needs efficiently. Part IV reviews current thinking and policies and discusses ways in which formal and informal approaches might be effectively combined.

UNESCO, Science and Technology in the Development of the Arab States, UNESCO, Paris 1977

III The papers of a UNESCO Conference of Ministers of Arab States Responsible for the Application of Science and Technology to Development in Rabat Morocco in 1976. The first part consists of the Final Report of the Conference, while the second part contains the main working document of the conference.

Ward, F.C., Education and Development Reconsidered: The Ballagio Conference Papers, Praeger Publishers, New York, 1974

III A collection of twenty papers organised into five sections. The first examines education as an economic investment; the second deals with education and social justice; the third with planning, research and development in education; the four with the universities and national development and the final section examines the implications of the foregoing discussion of external assistance to education.

Section 2b: The Science and Technology Curriculum

The central questions which are addressed explicitly or implicitly by the material in this section are: what is to be taught, and how? Even when the objectives of the education system, both formal and informal, have been specified and the scale of resources to be made available to schools has been determined, it remains to be decided precisely what should be taught. This bibliography was commissioned and constructed on the assumption that it is important to ensure that what pupils actually learn is relevant to their real and perceived needs and to their local conditions. This means that science and technology education in Developing Countries cannot simply imitate science and technology teaching in the Industrialised Countries, and that relevance to social needs has to be determined locally. This does not mean, however, that Developing Countries cannot learn anything from the experience of the Industrialised Countries. On the contrary, Developing Countries have an opportunity to learn both from the achievements and from the mistakes of the Industrialised Countries. Starting in the 1960's, but continuing into the 1970's and 1980's, considerable attention has been paid in the Industrialised Countries to improving the teaching of science and technology. Improvements have been sought both in the material which is taught, and the methods by which pupils learn and are taught. The motivation behind these developments have probably been based on a concern for commercial, industrial and national competition, but in a competetive world these are considerations which it is foolish to neglect.

Attempts have therefore been made to transform the teaching of science and technology in the Industrialised Countries to make them more relevant to the social and economic needs of those countries. For some years many Developing Countries have been, and are now increasingly, seeking to ensure that science and technology education which they are providing is relevant to their needs. This means that Developing Countries might be able to learn something from the experience of the Industrialised Countries, but only as long as they do not simply imitate their actions, but rather instead develop their own syllabuses and curricula to suit their own national and local needs.

This section of the bibliography is distinctive in that it does contain a large proportion of material which is suitable for use directly by pupils, at any rate in the Industrialised Countries. Much of the material which is listed is designed to assist pupils to appreciate the social relevance of science and technology and to contribute to their preparation for work as responsible professional scientists and technologists. These materials may therefore be valuable as a guide to science and technology teachers in Developing Countries but only in so far as they appreciate the necessity to modify and adapt the available materials to deal with local issues and conditions.

Much of the developments in science and technology education in the Industrialised Countries have been designed to modify classroom practices so that pupils are not simply presented with science as a set of fixed conclusions, but rather learn to discover facts and principles for themselves. These developments have occured for several reasons. Some have argued philosophically that more traditional educational practices have misrepresented the true nature of science as a set of final and immutable truths, rather than as a dynamic and problematic system of learning. More pragmatically, others have argued that the attention and enthusiasm of pupils can most easily be engaged if they feel that they have something to contribute. Moreover, it has been argued that a dynamic innovative industrial economy requires people who are able to think for themselves, and to be imaginative and not merely to apply and reproduce existing scientific knowledge or technological solutions. For all of these reasons, and others, science and technology education has been reformed and improved over the last twenty years. Much of the material listed in this section is intended therefore to make science education more pupil-centred and more demanding of the imagination and intelligence of the pupils that was the case with more traditional teaching methods.

Inevitably, when discussing the social relevance and impact of science and technology in classrooms, and in less formal learning situations, issues of social and political controversy will arise. Some of the material listed below seeks to deal with these problematic issues, but not by providing simple answers to complex questions, but by providing materials which will serve to encourage informed thought and discussions permitting participants to learn to reach decisions for themselves in a responsible fashion.

Allen, G., Biotechnology: What is it? Where is it going?, Unilever Topic Series No.9, Unilever Educational Publications, London, 1983

II Originally a lecture to the Standing Conference on School Science and Technology, it has now been published in this 'Topic Series'. Together with the previous eight titles in the series, a package of reading material is available for the study of issues as seen by a multi-national involved in the science, technology and society interface. Up to twenty copies of each title in the series can be obtained free from the Unilever Education Section.

Allsop, R.T., Freeman, J.M. & Ingle, R.B., 'Chemical Industry in Developing Countries', Education in Chemistry, Vol. 8, No.6, 1971, Chemical Society, Burlington House, London WIV OBN, pp.226-229

II In the past school chemistry courses in Developing Countries have blindly followed the curricula laid down in the 'mother' country, regardless of their relevance to local conditions. This situation is changing. New curricula will allow the development of courses with a distinctly local flavour. This article examines ways in which this can be achieved in tropical Africa.

Association for Science Education, Rethinking Science. Teaching Science in its Social Context, Occasional Papers, ASE, January 1984

II This report and discussion document was prepared by an ASE working party on the 'Interactions of Science with Society in the Curriculum' of the 11-16 year old. It represents proposals to enable young people to discuss social and economic issues related to science and technology, in their science lessons. It describes a number of strategies used by science teachers to incorporate social issues into their teaching. It raised points to stimulate discussion and re-appraisal of teaching methods. It presents case studies for the early years (e.g. on water and disease; housing around the world); and in the third year (e.g. biotechnology, food, plastics, nuclear energy, industrial chemistry and pollution, etc.). Methods of teaching are indicated (e.g. discussions, role-play, simulations, etc.).

Baez, A.V., Innovation in Science Education World-Wide, UNESCO, Paris, 1976

II A wide-ranging account of efforts to improve science education which includes a set of proposals which are based on a systems-approach to science education.

Boyle, C., Wheale, P. & Sturgess, B., People, Science and Technology, Wheatsheaf Books, Ltd., Brighton, 1984

II The book presents multi-disciplinary analysis of the social implications of technological developments and surveys the economic, sociological, historical and political aspects of science and technology. Effects on management, health, food, agriculture, genetics, television, micro-electronics, work and armaments are considered. The ability created through technology to control and manipulate the environment and humans leads the authors to argue for the control of science and technology.

Briggs, J.G.R., 'A Problem with Alcohol', Education in Chemistry, Vol. 15, Non.4, 1978, Chemical Society, Burlington House, London WIV OBN, pp.122-123

II Finding a good idea for a school chemistry project is difficult enough in Britain. In Developing Countries it is doubly difficult. Few pupils are interested in doing anything that is not examination oriented and there is also a problem in finding a topic which excites their interest. This article describes how a major pupil interest was developed into a useful project.

Brophy, M. & Dalgety, F., 'Curriculum Diffusion and Adaption: A West Indian Experience', Education for Development, Vol. 6, No.4, Oct. 1981, pp.53-62, Journal of the Faculty of Education, University College, Cardiff, Wales

II Many Developing Countries have centralised education systems in which the schools must follow the curriculum decisions of central officials. Innovations in the curriculum are therefore readily diffused, yet there may be severe problems of implementation. By reference to the experience in the West Indies and in Guyana, the authors identify some of the benefits and pitfalls of centralisation. They argue that what was originally conceived as a laboratory-based, pupil-centred, activity programme, in many schools became a traditional teacher-centred, text-book oriented course with the minor benefit of using local examples.

Chemistry Case Studies: The Industrial Production and Use of Sulphuric Acid. The Products of the Chlor-alkali Plant. The Stringent Industrial Control of Pollution. Available from: Holly Resources Centre, Sheffield, England.

II These case studies are designed for fourth and fifth year pupils taking O-level and equivalent examinations. They have been developed through collaboration between teachers and Stavely Chemicals Ltd. The pack of three give a definitive view of industrial processes vital to the economic growth of a country. The materials have been trialled in eightly secondary schools. They offer an important enrichment to the basic 'academic' treatment of the subject by bringing to the pupils an awareness of the real world. The pack consists of a class set for each case study together with a teacher's guide; OHP transparencies; a set of TREM cards required in the transport of dangerous loads; and some vanadium pentoxide catalyst.

Coggin, P.A., Technology and Man, A. Wheaton & Co. Ltd., 1980

II A course of study particularly relevant to sixth-form (or equivalent) courses in science, technology and society. It aims to meet the three broad objectives of the Schools Council 'Project Technology'. It is based on materials developed at Park Senior High School, Swindon and deals with the nature of technology, its possibilities and limitations; and its organisation. Suggestions for pupils activities to accompany the text are provided. The course is designed tc be taught by a single teacher or by a team. Useful ideas for further reading and work are given.

Cunningham, P.J. (ed.), Science, Technology and Education, Proceedings of the Annual Conference, International Standing Conference for the History of Education, 1983

III Eighty papers delivered by participants from 24 countries at the annual conference, organised in six volumes: Education and economic performance; National and international diffusion; Science, technology and the school curriculum; Science, technology and higher education; Education, science and technology in pre-industrial societies; Education, science and technology since 1945.

Dallas, D., Teaching Biology Today, Hutchinson Educational Ltd., London, 1980

III An attempt to deal comprehensively with the demands of, and possibilities in, the teaching of biology to school pupils. It particularly considers the planning and organisation of lessons, mixed-ability teaching and the use of audio-visual aids.

Dart, F.E. & Pradhan, P.L., 'Cross-cultural teaching of science', Science, Vol. 155, No.3763, 10 Feb,. 1967, pp.649-656

II The authors of this article argue that the teaching of science is often singularly insensitive to the intellectual environment of the students, particularly in Developing Countries. The authors seek to show that a proper appreciation of the child's intellectual environment can lead to significant improvements in the teaching and learning of science. This paper is some 17 years old, but it is not at all clear that the arguments presented have yet been fully appreciated.

Diamond, D., Introduction and Guide to Teaching Primary Science, Macdonald Educational Ltd., 1978

II This is an introduction to a set of ten books under the series title of Teaching Primary Science. The work results from a project sponsored jointly by the Nuffield Foundation and the British Social Science Research Council. The series has been produced specifically for class teachers and trainee teachers. The books do not assume any scientific training on the part of the teachers and they seek to stimulate creative and imaginative inquiry by teachers and pupils into the behaviour of their everyday environment.

Doraiswami, F., 'The New Biology Syllabus in India for Middle and Senior High Schools as Developed by the National Council for Educational Research and Training in co-operation with UNESCO', Journal of Biological Education, Vol. 4, No.1, 1970, pp.11-17

II A report on the work of N.C.E.R.T. with UNESCO to prepare a new biology syllabus for use in Indian schools. The two central objectives of this course are (1) to give a comprehensive and systematic knowledge of the world of living things and of man, on a scientific basis, and (2) to discover the basic principles of modern biology.

Eijkelhof, H., Boeker, E., Raat, J. & Wijabeck, N., Translated by Eijkelhof-Broth, J. Jones, S. & Williams, B., Physics in Society, VU Boekhaudel/Uitgevenij, 1981

II The text is based on materials developed and used in Dutch schools and suitable for the equivalent of the sixth-form in England. It covers: energy, sound, transport, weapons, science and technology in developing countries; the interaction of science, technology and society (historically and analytically); futures. The authors invite teachers and pupils to offer suggestions for improvements after trying the materials. It should take about 15 hours of lesson time to get through the material and a flow-chart is provided. Some choice of options is allowed in this programme. The text is directed at the pupils.

Ellington, H.I. & Addinall, E., et.al., 'The Nuclear Debate: Examination of the Issues', Physics Education, Vol. 16, 1981, pp.274-286 Published by The Institute of Physics, 47 Belgrave Square, London SW1

II At attempt to provide an outline discussion for school teachers on the controversial subject of nuclear power. The discussion is based on British data and covers both supply and demand issues as well as technical and social considerations.

Eulefeld, G., 'An Ecological Approach to Restructuring School Biology', Journal of Biological Education, Vol. 10, No.4, 1976, pp.196-202

II Intended for use with school pupils aged 10 to 15, the article outlines a human-centred ecological approach to a biology curriculum. It is structured around the interaction between the human species and its biological environment.

Everett, K. & Jenkins, E.W., A Safety Handbook for Science Teachers, John Murray, London, 1980

II Although the inherent risks of some laboratory work attract some pupils to science, it is vital that teachers ensure classroom safety at all times. This text assists teachers to plan and provide lessons in experimental work which are both safe and interesting.

Hawkins, D. 'Development as Education: A proposal for the improvement of elemenatry education', in Nader C. & Zahlen, A.B. (eds.), Science and Technology in Developing Countries, Cambridge University Press, 1969, pp. 521-539

II An attempt to specify in general terms the social and intellectual conditions in which education (particularly in science and technology) can become increasingly relevant to the needs of the pupils and the rural communities as a whole. Modern mass education is characterised as a sterile failure and a more effective and constructive alternative is proposed but it can be achieved only by the articulation and implementation of government policies, orientated towards the formation of human capital appropriate to the local opportunities for economic growth.

Head, J. (ed.), Science Education for the Citizen, Part 6., 'Science, Technology and Society, pp.101-129', Proceedings of UK-USA Seminar, Jan. 1982, under auspices of The British Council and National Science Teachers Association (USA), Chelsea College, London, England, 1982

III The seminar papers as a whole address the problems of redefinition of the nature of, and appropriate priority of the aims of, an education in science which all citizens must have in tomorrow's world. The approaches adopted then were broad and far wider in perspective than those set by the needs of educating the most able to be future scientists. Part 6 on 'Science, Technology and Society' contains discussions on the tension between science education and humanistic education; teaching about Science and Society; technology in the science curriculum in the U.K.; putting science into a 'social context' in the classroom; and a discussion of the concepts involved in this field of study.

Ingle, R.B. & Turner, A.D., 'Science Curricula as Cultural Misfits', European Journal of Science Education, 1980, Vol. 3, No.4, pp.357-371

II A review of recent developments in the Industrialised Countries and of attempts to transfer those innovations to the Developing Countries. The authors maintain that in many significant respects, curriculum developments which may well have suited the countries which initially introduced them, do not suit Developing Countries to which they have subsequently been transferred; and this can be true despite conscious efforts to adapt them to their new environments.

Jerrard, B. (coordinator), Science in Society Data Project, Centre for Environmental Education, Gloucestershire College of Arts and Technology, Gloucester, England, 1982, 1983

II Annual updates of data for the Science in Society Project (John Lewis, see below). Printed tables in A4 and A5 format for duplicating. It is intended to use international data banks; to provide material on disc or cassette for use in micro-computers; and for broadcast data systems.

Lewin, K., 'Science Education in Malaysia and Sri Lanka', IDS Discussion Paper 74, Institute of Development Studies, Brighton, England, 1975

II Science courses designed or adapted for use in Developing Countries seem rarely to meet criteria of relevance to the future lives of most pupils. The author argues that the examination oreintation of most classrooms tends to favour the rote learning of factual information and that this runs counter to the aims of many new science education programmes which aim to promote a grasp and application of general scientific principles. This paper reports the results of a study of the factors which promote or inhibit the ability of pupils to understand and apply scientific knowledge.

Lewin, K., Qualification and Selection in Educational Systems: Selection and Curriculum Reform in Science Education in Malaysia and Sri Lanka, Institute of Development Studies, Brighton, England, 1981

III A summary report of a major study. This paper provides just a brief introduction, a summary of major findings, and a concluding discussion based on a detailed research project in developments in science education in South Asia.

Lewis, J. (Project Director), Science in Society Project, Heinemann, for the Association for Science Education, 1981

II The materials produced by this project consist of a Teacher's Guide and sixteen pupils' topic books, nine decision making exercises and audio-tape discussions. The Guide covers the aims and objectives of the course, and the subject matter covered. Health and medicine, population, food and agriculture, energy, mineral resources, industry in the economy, resources of land and water, futures represent the main content. These themes are then covered by short articles in the pupil booklets., The guide also indicates clearly the kinds of pupil activities that can be undertaken with this kind of subject matter. (See also: Jerrard, B., Science in Society Data Project.)

Science in Society, Teachers Guide, Heinemann Educational Books & Association for Science Education, 1981

II An introduction to, and summary of, the pupils texts, and advice on how they could be used in classroom teaching.

Science in Society, Book A: Diseases and the Doctor, Heinemann Educational Books & Association for Science Education, 1981

II A pupil text, dealing with 14 topics in a space of 64 pages. Only three of the topics are appropriate to health problems in Developing Countries.

Science in Society, Book B: Population and Health, Heinemann Educational Books & Association for Science Education, 1981

I This unit does discuss the desirability of seeking prevention, rather than cure and discusses the health of the disadvantaged sectors of society. The discussions of sex and population seem designed to avoid controversy, but in fact are particularly controversial because of their approach. For example, on population, the text simply presents the views of Malthus while ignoring the mass of criticisms which that position has received.

Science in Society, Book C: Medicine and Care, Heineman Educational Books & Association for Science Education, 1981

I A pupil text with nine brief sections on: A short histroy of medicine, immunization, the development of new drugs, the limits of medicines, experiments on animals, care of the elderly, care of the dying, bereavement and suicide.

Science in Society, Book D: Food, Heinemann Educational Books & Association for Science Education, 1981

I A traditional and unimaginative treatment of the issues. It takes a technocratic approach and operates in a Malthusian framework. It fails to deal adequately with the fact of overproduction, or with the social limitations on e.g. the Green Revolution.

Science in Society, Book E: Agriculture, Heinemann Educational Books & Association for Science Education, 1981

I A pupil text written within an ecological perspective provides a reasonable treatment and quite a lot of plausible empirical data. Divided into seven section on: ecology and food production, energy in agriculture, energy to live, agriculture and the environment, farming today, and soil - our real wealth.

Science in Society, Book F: Energy, Heinemann Educational Books and Association for Science Education, 1981

I A pupil text, essentially about Britain's energy needs. It takes a very complacent view of the economics and safety of nuclear power generation and omits a wide range of crucial social and political considerations.

Science in Society, Book G: Mineral Resources, Heinemann Educational Books & Association for Science Education, 1981

I A pupil text, essentially a technical and technocratic treatment of geology, mining and mineral extraction which barely addresses many crucial issues.

Science in Society, Book H: Industry: Men, Money and Management, Heinemann Educational Books & Association for Science Education, 1981

I A pupil text designed to explain the point of view of industry to school pupils. It emphasises the need for team work and describes the industrial field as characterised by co-operation rather than conflict or competition. It emphasises too the importance of scientists and technologists as well as that of managers and trade unions.

Science in Society, Book I: Industry: Organisation and Obligation, Heinemann Educational Books & Association for Science Education, 1981

I A pupil text dealing with the role of research and development in industry, the ways in which firms and industries are organised, and their responsibilities for the social and environmental consequences of their actions.

Science in Society, Book J: Nature of Science, Heinemann Educational Books & Association for Science Education, 1981

I A pupil text intended to provide a basic simple introduction to questions in the philosophy of science about the character of scientific knowledge and method. It discusses particularly the role of imagination in scientific progress, the nature of truth and the relation of science to religion.

Science in Society, Book K: Science and Social Development, Heinemann Educational Books & Association for Science Education, 1981

I A pupil text designed to portray the development of European culture from ancient Greece to the present day as progress to enlightenment. It presents science and technology as esentially progressive forces, and emphasises the benefits they have brought.

Science in Society, Book L: Looking to the Future, Heinemann Educational Books & Association for Science Education, 1981

I A pupil text for British schools which emphasises the optimistic aspects of future possible scientific and technological changes.

Science in Society, Book M: Engineering 1, Heinemann Educational Books and Association for Science Education Ltd.

I A pupil text which consists of nine brief chapters, seven of which were commissioned by the Fellowship of Engineering. By reference to British examples, it discusses the problems and importance of engineering in modern industrial society.

Science in Society, Book N: Engineering 2, Heinmann Educational Books & Association for Science Education Ltd.

I A continuation of Book M, consisting of seven chapters concerned essentially with the technology of transportation.

Science in Society, Book O: Engineering 3, Heinemann Educational Books and Association for Science Education Ltd.

I A continuation of Books M and N, consisting of twelve chapters concerned with the production and processing of oil, coal, gas and water.

Science in Society, Book P: Defence and Energy Issues, Heinemann Educational Books and Association for Science Education Ltd.

I A review of the controversial issues of nuclear weapons and nuclear power developments.

Maybury, R.H., Technical Assistance and Innovation in Science Education, John Wiley & Sons, New York, 1975

II This study examines five attempts at improving science education in Argentina, Brazil, Lebanon, the Philippines and Turkey. These five programmes were funded by the Ford Foundation and they are reviewed by the Deputy Head of UNESCO's field office in Nairobi. Part I contains descriptive accounts of the five case studies; while part II provides a comparative analysis and a set of conclusions on how to innovate in science education in Developing Countries and the demands these innovations make on technical assistance.

Morgan, D.R., 'Salt Production in Tanzania', Education in Chemistry, Vol. 8, No.1, 1971, Chemical Society, Burlington House, London WIV OBN, pp.21-22

II A new secondary science project in chemistry, adapted from the British Nuffield scheme, was introduced to East African schools. In this, traditional techniques based on empirical scientific processes provide a valuable link between school science and life at home which, for most, is in a rural agriculture-based village.

North West Community School, Technology and Science - A Whole School Policy, Mimeographed, Westminster, London, U.K., Jan. 1982, 22pp.

II A statement of the rationale, aims and criteria (e.g. awareness, competence) for a Technology and Science syllabus devised on a "whole-school" basis, it forms a dimension of the curriculum that is accessible to all pupils. It also incorporates simultaneously other "whole-school" policies, e.g. no overt or hidden sex-stereotyping. It sets out detailed analytical contents of the criteria to demonstrate their nature, e.g. resource allocation, integration of knowledge, historical influences, futures, control and technologies and tools for systematic analysis; the industrial and economic context; 'everyday' context; resources; scientific and technological knowledge; systematic approaches; decision-making; attitudes; evaluation.

Olson, J. (ed.), Innovation in the Science Curriculum: Classroom Knowledge and Curriculum Change, Croom Helm, London & Canberra and Nichols Publishing Co., New York, 1982

III This volume contains five thoughtful and specially commissioned papers including two by the editor. The central argument is that curriculum innovation and reforms will only be successful if they are informed by a proper appreciation of what can and does occur in classrooms. Too many proposed innovations which were initially plausible and attractive, were eventually unsuccessful because they were devised in abstraction from any appreciation of the realities of the classroom.

PLON, Physics Curriculum Development Project, PLON Laboratory Vaste Stof, Princetonplein l. Postbus 80.008, 3508 TA Utrecht, Holland.

II The project developed since 1972, aims to link physics, taught in the 12-18 schools, to the everyday life of the pupils and deals with technology as well as science. It shows the relation between physics and society. The PLON materials should allow of 'mixed ability' teaching and, as well, individualised learning. It also encourages co-operative work. Units are organised for each of the different age ranges 13/14 to lo6/17. Such units as "Physics in Society: Water for Tanzania" for 14/15 year olds illustrates the aims of the project.

Richmond, P.E. (ed.), New Trends in Integrated Science Teaching, Vols. 1-4, UNESCO, Paris 1971. Vol I. 1969-70 (42 papers); Vol II 1973 (9 papers and descriptions of 6 projects); Volk. III 1973 (22 papers); Vol. IV 1977 (edited by D. Cohen) (16 papers)

III The first two volumes attempted to exemplify and to analyse world-wide trends in the integrated teaching of basic science. Volume III discussed the education and training to teachers, while Volume IV examines the evaluation of integrated science education.

Science Technology and Society Association and European Association for the Study of Science and Technology, Choice in Science and Technology, Conference Papers, Joint EASST/STSA Conference, London, 1983

III The conference papers consider the "choice paradigms" for a wide range of science, technology and society cases, e.g. in policies for medical advances, ecology, nuclear energy, energy generally. Questions concerning various policy options for both developed and developing countries are considered. The nature, extent and location of choice present a challenge not only to the "practitioners" but also to teachers of science, technology and society.

Solomon, J., 'Science and Society Studies in The School Curriculum', The School Science Review, Vol. 62, No.219, Dec.1980, pp.213-219

II A brief review of the introduction of considerations of the social role of science into science teaching in Britain. The argument is that the curriculum and the pupils' appreciation of the significance of science are enriched by dealing with the social relations of science. The paper also considers how such material can be taught and identifies an outline syllabus.

Solomon, J., 'STS for School Children', New Scientist, vol. 89, 8 January 1981, pp.77-78

II 'STS' is a modern abbreviation for 'Science, Technology and Society', and this paper briefly reviews the efforts in Britain to incorporate consideration of these issues into the teaching of science in schools.

Solomon, J. & Addinell, S. (eds.), Science in a Social Context, Blackwell for the Association for Science Education, 1983

II Based on a course developed and taught by teachers in a number of London schools, the materials include a Teachers' Guide and eight units with pupils' booklets. The guide sets out aims and objectives, ways of teaching and routes through the several Units. Units cover: ways of living; nature of scientific enquiry; technology, invention and industry; evolution; the atomic bomb; energy; health, food and population; space cosmology and fantasy.

Solomon, J., Ways of Living, Association for Science Education, Blackwell & SISCON, 1981

I A pupil text designed to provide an introduction to human and natural ecology by taking a comparative approach and exploring the ways in which different kinds of societies live in different ways with their environments.

Solomon, J. Energy: The Power to Work, Association for Science Education, Blackwell & SISCON, 1983

I A pupil text which provides an initial introduction to the concept of energy and the generation and uses of energy. It reviews current and future problems in its availability and use both in industrialised Britain and in Developing Countries.

Solomon, J., Health, Food and Population, Association for Science Education, Blackwell & SISCON, 1983

I A pupil text dealing carefully but simply with health and food in Britain and in Developing Countries.

Solomon, J., Technology, Invention and Industry, Association for Science Education, Blackwell & SISCON, 1983

I A pupil text on the role of science and technology in modern industrial developments. It discusses the market conditions under which science based inventions can be incorporated into new products and processes. It illustrates the main themes with two case-studies, one on the development of plastics, and the other on the development of electronics from its earliest days to the microchip.

Solomon, J., How Can We Be Sure?, Association for Science Education, Blackwell & SISCON, 1983

I A pupil text designed to assist children to think critically about the character of scientific knowledge and methods. It locates the whole discussion against the background of 'Why We Need to Know' yet emphasises the extent of disagreement between experts. It explains that science does not have and may never have, the final and complete truth and encourages pupils to think critically about what they learn and how it is taught and learnt.

Solomon, J., The Atomic Bomb, Association for Science Education, Blackwell & SISCON, 1983

I A pupil text which directly addresses one of the most crucial issues concerning the social role of science and technology. It starts from an account of science and scientists on the payroll of governments and industry, then reviews the discoveries of nuclear physics and atomic energy. It describes the establishment of the Manhatten Project to build atomic weapons during the Second World War in the United States of America and their use against Japan in 1945. It concludes with a discussion of subsequent developments in the international arms race and the search for world peace.

Solomon, J., Evolution and the Human Population, Association for Science Education, Blackwell & SISCON, 1983

I A pupil text which introduces the main concepts of the modern version of Darwin's Theory of Evolution. It reviews the scientific and religious arguments for and against neo-Darwinian evolutionary theory and presents Darwinism as a plausible hypothesis rather than as an established conclusion. It then explores some of the limitations of simply applying the theory to the evolution of human society, and finally discusses some possible future technological developments to which biological science may lead.

Solomon, J., Space, Cosmology and Fiction, Association for Science Education, Blackwell & SISCON 1983

I A pupil text which reviews the historical developments of cosmological theories from earliest creation myths to modern science. It summarises space exploration to date, and relates it to imaginative discussions in science fiction.

UNESCO, New Trends in Biology Teaching, UNESCO, Paris

III Volume I, ed. R. Heller, 1966.
Much of this volume is in French, some is in English, but it contains summaries in Spanish. Part 1 deals with general issues of the teaching of biology. Part 2 deals with the adaptation of teaching to local conditions. Part 3 lists work done and sources of information.

Volume II, ed. R. Heller, 1969.
This four part volume includes papers in both English and French. Part 1 deals with general matters. Part 2 reviews individual disciplines; Part 3 examines educational methods and techniques, and Part 4 discusses local developments.

Volume II, ed. R. Heller, 1971
This volume extends and updates the previous volume.

Volume IV, 1977
This volume is entirely in English and contains eleven papers which together provide a comprehensive survey of developments in biology teaching.

UNESCO, New Trends in the Utilization of Educational Technology for Science Education, UNESCO, Paris, 1974

III This volume reviews trends in the use of educational technology to improve the teaching and learning of science. The papers in this volume cover a wide range of relevant and related issues including the use of computers and other programmed learning systems. The use of television, radio and other media. There is also a discussion of the role of educational technology in the professional training of science teachers.

UNESCO, The New UNESCO Source Book for Science Teaching, UNESCO, Paris, 1973

III This book is intended for science teachers and it is both thorough and well illustrated. Detailed information is provided on how to make simple low-cost equipment and materials for demonstrations and for experiments to be conducted by pupils and students. There are also included proposals on equipment maintainance and particularly on ways of avoiding mould and corrosion of equipment especially in tropical regions.

UNESCO, New Trends in Chemistry Teaching, UNESCO, Paris
Vol. I 1964-65, (ed.) E. Cartwell
Vol. II 1969, (ed.) E. Cartwell
Vol. III 1972, (ed.) E. Cartwell
Vol. IV 1975
Vol. V. 1981

III A sustained systematic, comprehensive and cummulative survey. The first three volumes are divided into sections, each one reflecting a topic in chemistry. Volume IV contains 13 papers; eight of them dealing with factors affecting the design of chemistry courses and programmes and five exploring other aspects of chemistry education. Volume V is divided into nine sections and comprises altogether 59 papers. They deal in turn with (1) Chemical Information; (2) What Should We Teach and How?; (3) Chemistry in Space; (4) Chemistry of the Future; (5) Controversies in Teaching Chemistry; (6) Simple Experiments; (7) Low-Cost Equipment; (8) Games and Simulations; and (9) Chemistry and Industry.

UNESCO, New Trends in Physics Teaching, UNESCO, Paris
Vol. 1 1965-66, prepared by W. Knecht
Vol. 2 1970, ed. by E. Nagy
Vol. 3 1976, ed. by J.L. Lewis

III Volume I reviews international, regional and national activities in innovative physics education, dealing in particular with 18 Industrialised Countries. Volume II examines course contents, laboratories, methods and media testing and it then reviews some new physics courses. Volume III is based on the proceedings of an International Conference in Physics Education held in Edinburgh in 1975 and contains 20 papers on a wide range of relevant issues.

UNESCO, Curriculum Design in Engineering Education, (Progress report on the work of the UNESCO International Working Group), Paris, UNESCO, 1976, pp.34

II This brief report examines some of the problems involved in modifying engineering education so as to improve co-operation between industry and education in Developing Countries. The approach assumes that improved education is a condition for enhancing the extent of technology transfers and making those transfers more beneficial to the receiving country.

Watson, J.G., 'The American Science Educator in a Developing Country: A Review of the Literature', American Journal of Physics, 1978, Vol. 46, No.10, pp.971-975

II This article is an attempt to begin a systematic review of the literature concerning the role of the American science educator in Developing Countries. Three major areas are focused on: limited availability of science teaching facilities and materials, lack of experience on the part of both native teachers and the American science educator operating in a culturally different settling, and the general problems posed by language and cultural differences.

Wellington, J.J., 'Teaching the Unteachable - Physics Education and Nuclear Physics?', Physics Education, Vol. 17, No.3, 1982, pp.106-110

II A brief review of the technical, social and political issues which will inevitably arise in a school discussion of the use of nuclear physics for military purposes. The article describes how to incorporate these questions into the curriculum, it discusses 'what should be taught?' and outlines some available resources.

Williams, J.R.P. & Pullan, M., 'On the adaptation of Indian teachers to a short course on Nuffield Biology', Journal of Biological Education, 1971, vol. 5, No.4, pp.173-177

II The Nuffield Foundation in Britain has devoted a great deal of energy to developing the syllabuses of school science teaching to improve the ability of pupils to learn for themselves rather than merely to consume predigested material. This brief paper provides a report of a course designed to assist teachers from India to adapt Nuffield Biology courses ror use in their local schools.

Ziman, J., Teaching and Learning about Science and Society, Cambridge University Press, 1980

II An attempt to explore the rationale of Science, Technology and Society teaching as it has grown up in recent years in higher education, especially, but also at secondary school level. It argues that conventional science education (in England) gives misleading conceptions of the capabilities and social function of science. A schematic model is then presented that relates the spheres of 'academic' science, the research and development system, and their social context. Lastly, it presents a schema for the current varieties of approaches to teaching STS material. Admittedly a personal view, nonetheless it represents the valuable overview and perspective for those undertaking such teaching, of the Chairman of the Council of Science Studies in the U.K.

Section 2c: Scientific and Technological Education for Girls, Women, for Minorities and Other Disadvantage Groups

No-one disputes the claim that scientific knowledge and education are not uniformly available to all social groups. In particular, it is generally recognised that girls and women have less access to scientific and technological education and resources than is the case for boys and men. The material in this section falls roughly into two parts. Some of it seeks to describe and to explain this state of affairs, while much of the remainder seeks to identify policies and practices for remedying these deficiences. While the majority of the material in this section discusses the problems of girls and women, some of the material considers the problems of minorities and other disadvantaged groups.

When considering why the participation rates of girls and women in science and technology are so low the main question is whether these inequalities are simply a reflection of the sexual division of knowledge and power in the ambient society or whether there is something special about science and technology which makes access to them by females particularly difficult. Some authors argue that as presently constituted there is something distinctively masculine about science and technology, while others argue that their apparent masculinity is a superficial property, and that modest changes in presentation would enable girls and women to have vastly great access than at present.

When considering how to remedy prevailing inequalities the discussion generally turns on how much changes are needed within the scientific and engineering communities and professions, and the extent to which more profound changes are required in the ambient societies. It is generally recognised that in most Developing Countries the work load on women is higher than that on men, while at the same time the access of women to the technology which would lighten their load or raise the productivity of their labour is significantly less than for men. This means that potentially at least, the diffusion of technology and technological innovations could benefit women disproportionately, and therefore a greater return on investment in female activities might be expected over corresponding male activities. The potential benefits, however, which might accrue are likely to be in the domestic and/or rural sectors, and therefore are not likely to be readily calculated as part of the Gross Domestic Product, and therefore unlikely to receive the recognition which they might perhaps deserve.

The issues raised in this section are not simply scientific or technological but are rather cultural, social, psychological and political, and generally have very deep historical roots. This probably means that they are amongst the hardest to solve, but this might be thought to make them more rather than less significant.

Byrne, E., 'Inequality in Education - Discriminal Resource-Allocation in Schools?', in Meighan, R. & Doherty, J. (eds.), Education and Sex Roles, Special Issue of Educational Review, Vol. 27, 1975, no.3, pp.179-191

II By reference to British data the authoress argues that educational resources are uneven, and that the criteria which operate in practice entail that pupils will suffer if they are less able in rural areas, older, and female. Hence, a less able girl in a rural area is likely to be exceptionally deprived of educational resources.

Byrne, E., Women and Education, Tavistock Publications, 1978

II The authoress believes that much modern education is permeated by a 'hidden curriculum' of sex-typed educational practices. She examines many modern educational policies and exposes the continuing basic problems of the severe under achievement of girls and women, and of the missing role of women in the government of education. The empirical material is drawn essentially from the British educational system, but the ideas developed are intended to be more generally applied.

Carr, M., Appropriate Technology for African Women, 1978, from African Training and Research Centre for Women, U.E. Economic Commission for Africa, P.O. Box 3001, Addis Ababa, Ethiopia

II A report of the needs of, and possibilities for, women in the processes of economic development, with particular reference to their interaction with appropriate technologies. It emphasises the special role for technical education for girls and women. It also includes a review of some small-scale technology related projects in Africa, and an annotated bibliography on women and technology in Africa.

Carr, M., Women and Appropriate Technology: Two Essays, Intermediate Technology Development Group, London, 1982, Occasional Paper No.5

II The first essay deals with the demanding work load of rural African women, the way that their potential and actual contribution to development has tended to be neglected by development planners, and the way that technological changes have harmed women's work and lives, thus hindering the development process. The second essay concedes that women's role in development has been belatedly recognised, and discusses how this recognition can be translated into action by assisting women to gain access to technologies which could raise the productivity of their labour.

Couture-Cherki, M., 'Women in Physics', in The Radicalisation of Science, Rose, H. & Rose, S. (eds.), Macmillan, 1976

II An essay which is both descriptive and analytical, and based on the experience of the authoress working as a physicist in France. She reviews the distribution of women among professional physicists, and examines the ideologies of both professional and family life.

Curran, L., 'Science Education: Did She Drop Out Or Was She Pushed?', in Alice Through The Microscope, Birke, L. et al. (eds.), Virago, London, 1980

II A review of some of the evidence and arguments concerning the participation of girls and women in science education. The question in the title is intended to be rhetorical, for the author argues that girls are systematically excluded from science education.

Davies, L. & Meighan, K., 'A Review of Schooling and Sex Roles, with Particular Reference to the Experience of Girls in Secondary Schools', Educational Review, Vol. 27, No.3, June 1975, pp.165-178

II A review of the literature concerning the relative performance of girls and boys at school, and a consideration of the particular problems encountered by girls. A discussion of the explicit and hidden curricula as they affect girls and a report on case studies of two schools.

Easlea, B., Science and Sexual Oppression: Patriachy's Confrontation With Women and Nature, G. Weidenfeld & Nicolson, London, 1981

II This is a quite exceptional study of sexism in Western science. The author explains how Francis Bacon and other founders of modern science set out to create a truly masculine image of nature and he then explores how science and particularly biology has described and theorised femininity especially in accounts of reproduction. He argues that these ideological currents played a crucial role in the development of European fascism, and concludes with a discussion of alternatives to oppression and to a culture of virility.

Eddowes, M., Humble Pi: The Mathematics Education of Girls, Longman, for the (British) Schools Council, 1983

II A review of the limited extent and achievements of mathematics education for girls in Britain. It details their relative involvements, abilities, attitudes and attainments. It then addresses the question of what can be done to overcome the lack of involvement and achievement by girls in this field, and concludes with a set of recommendations for action by teachers who wish to contribute to progress.

Eshiwani, G.S., 'Sex Differences in the Learning of Mathematics among Kenyan High School Students', Kenya Educational Review, December 1975, pp.111-119

II A report of a study of the performance and achievements in mathematics of groups of boys and girls in Kenyan secondary schools. The results suggest that unlike the situation in the Industrialised Countries, attitudes to mathematics and expectations of sex roles did not significantly affect pupil performance, but that the teaching methods adopted by teachers was a major factor influencing attainments.

Harding, J., Switched Off: The Science Education of Girls, Longman, for the Schools Council, 1983

II This pamphlet is the product of a joint study by the British Schools Council and The Equal Opportunities Commission. The author provides an account of the relative under-representation of girls in science education; an explanation of how it has come about and a set of policies to redress the imbalance.

Gormick, V., Women in Science: Portraits from a World in Transition, Simon & Schuster, 1984

III A report on a series of extensive interviews by a woman with women scientists in American academic life. The scientists interviewed varied widely in age and status. The women report that they have a profound affection for science but that they have had to endure harrassment and humiliation in the course of their careers, and these are some of the few who stayed the course.

Kelly, A. (ed.), The Missing Half: Girls and Science Education, Manchester University Press, 1981

III A set of 20 papers addressing the problems of under participation and under-achievement in science and science education by girls and women. After an editor's introduction, there are five papers on theories of sex differences, followed by ten reports of research studies of many aspects of the problem, and three papers reporting personal experiences and finally the editor discusses what action should be taken to "retrieve the missing half."

Keller, E.F., 'Gender and Science' in Discovering Reality, S. Harding and M.B. Mintikka (eds.), Reidel, Dordrecht, Holland, 1983

II The author argues that the fact that the scientific community is male is not just a simple reflection of gender differences in the wider society but rather that it reveals something specifically about science. She rejects explanations in terms of biology and genetics and offers an explanation rooted in Freudian psychoanalytic theory. She argues the formation of a masculine gender identity tends to prepare boys for science in a way that is less likely to occur for girls.

Lantz, A.E. et.al., Re-entry Programmes for Female Scientists, Praeger Publishing, New York, 1980

IV A detailed report of an empirical study in the USA of efforts by parts of the National Science Foundation to encourage higher rates of participation in science by women, and particularly to encourage women who have left science to re-enter the profession.

Mattfield, J.A. & van Aken, C.G., Women and the Scientific Profession, MIT Press, 1965

III This is the report of an early but important and earnest attempt to deal with the low rates of participation of women in science and engineering in the USA. The organisers of the 1964 symposium sought to acquaint girls seriously interested in careers in science and technology with some of the real and apparent difficulties which they may encounter, and to suggest that these difficulties are not insurmountable. They also wanted to show to people in industry education and the public at large that women do make valuable contributions in science and technology, and that it is desirable to dismantle barriers to enable them to realise their full potential.

Mitchnik, D.A., The Role of Women in Rural Zaire and Upper Volta: Improving Methods of Skill Acquisition, International Labour Organisation, Geneva, and Oxfam, Oxford, England, 1977

This brief working paper is concerned to examine the conditions for enriching the knowledge and skills of women in the rural areas of African Developing Countries. It recognises the particularly onerous role of rural women in economic activity and seeks to describe prevailing conditions as a basis for making policy prescriptions for their improvement. The study issues in a set of proposals for policies and research designed to encourage the participation of women in training programmes and argues that the two crucial factors which influence this process will be (a) changing attitudes and beliefs of men and women, and (b) changing training and rural development policies.

Open University Faculty of Educational Studies - E353, Society, Education and the State: Block 4: Class, Gender and Education, The Open University Press, 1981

II A student text which contains two units of Block 4 of the third level course in Educational Studies. These both concern class, gender and Education. Firstly they consider the role of educational institutions in teaching specific definitions of gender to children in preparation for their working and family lives. Then they consider the relationship between the issues of gender and of class in contemporary education. These units are written from a perspective which argues that it is necessary to recognise the importance of gender and class divisions in society and to identify the processes through which social inequalities are maintained and reproduced.

Razak, M.A., 'Innovation in Primary Science and Mathematics Curricula and Problems of Implementation in Malaysia', Education Development International, Vol. 1, No.2, 1973, pp.75-77

II A brief description of a project in rural Malaya intended to raise the poor performance of the local pupils in science and mathematics. The article describes the approach of the project and some of the problems which it faced.

Shepley, D., 'Obstacles to Women in Science', Impact of Science on Society, Vol. 25, No.2, pp.115-123

II Volume XXV, No.2, April-June 1975 of this UNESCO journal is entirely devoted to 'Women in Science: A Man's World'. It contains nine complementary contributions. This particular paper reviews some of the barriers to women's participation in science, and it proposes some measures which may serve to dismantle some of these barriers.

Stehelin, L., 'Science, Women and Ideology', in The Political Economy of Science, Rose, H. & Rose, S. (eds.), Macmillan, London, 1976

II The authoress of this essay examines ideologies both in science and of science insofar as they relate to women. She argues that science is governed by what she terms 'a masculine code', and discusses ways in which female scientists can and do struggle against it.

UNESCO, The Effects of the Policy of Apartheid on Education, Science, Culture and Information, UNESCO, Paris, 1967; 2nd edition, revised and enlarged, 1972

II This book has been revised at the behest of the U.N. Commission on Human Rights and was published to mark the International Year Against Racial Discrimination, in 1971. The first two sections of this volume provide a systematic review of the effects of apartheid on education and science in South Africa. It deals comprehensively with the subject, from primary schools to higher education examining policies, resources and syllabuses. As regards science, it examines patterns of employment, and the organisation of scientific communities in South Africa, as well as the impact on international co-operation. The final two chapters treat culture and information in a similar fashion.

UNESCO, Women, Education, Equality: a Decade of Experiment, UNESCO, Paris, 1975

II This volume was produced in connection with the 1975 International Women's Year, and it was intended to contribute to UNESCO's stock-taking exercise. It reports on three sponsored experimental projects in Upper Volta, Nepal and Chile. The review and analysis of the three projects is intended to provide an international audience with information from which guidelines for subsequent innovations in similar contexts might be developed.

Walford, G., 'Sex bias in physics textbooks', School Science Review, Vol. 62, Dec. 1980, No.219, pp.219-227, published by the Association for Science Education, College Lane, Hatfield, Herts., AL10 9AA

II After a brief review of the ratio of male to female participation rates in British science education, the author attempts to show how physics textbooks which are used in Britain present a starkly masculine image, and then artgues that a change could well encourage more girls to enter physics.

Walford, G., 'Tracking Down Sexism in Physics Textbooks', Physics Education, Vol. 16, 1981, pp.261-265

II The author demonstrates the extent of sexism and male-bias in standard British school physics textbooks. He examined the illustrations and questions as well as the texts and provides quantitative as well as qualitative evidence.

Section 3:
Science and technology in developing countries

Most Developing Countries acquired their institutions of science and technology education, and of research and development (R & D), from their former colonial powers. As a result the patterns of education and R & D which they possess frequently reflect the needs, interests and concerns of the Industrialised Countries rather than the needs and concerns of their own communities. It is, therefore, not just in economic matters that many Developing Countries are dependent upon the Industrialised Countries but dependency extends to their intellectual life as well. A relationship of dependency may entail that a Developing Country seeks to introduce or to develop technologies which are inappropriate to their own needs. Science and technologies which can be appropriate in one context might be entirely inappropriate in another. For example, the telephone might be efficient and operable at relatively low cost in an Industrialised Country. Yet it might be entirely unsustainable in a remote region of a Developing Country which lacks the necessary material and human infrastructural supports such as a reliable electricity supply and the skills to operate and maintain the system.

It is generally recognised that nations and communities who wish to participate in the world economy must either possess or seek to acquire an indigenous capability in science and technology. This should comprise a grasp of the basics of science, including some physics, chemistry, biology, medicine and engineering, and also at least some specialised expertise and skills. At least one reason for this is that, at a global level, modern microelectronic computer-based technology is displacing unskilled labour and contributing to a substantial reduction in the demand for unskilled personnel. This is important because an increasing proportion of the populations of Developing Countries live in urban areas, or in rural areas but without access to the means of independent subsistence, and so depend for their subsistence upon employment opportunities and wage incomes. In other words, if a Developing Country is to cope with the changes which are thrust upon it from the external environment, and if communities are to take control of their own destinies, they require home-grown and self-generating capabilities in science and technology. This capability involves knowing how imported technologies function, and the ability to service and improve imported technologies, and to innovate their own technologies based upon both traditional and imported forms. Furthermore, the capabilities which are required include not merely the technocratic ability to manipulate objects, theories and equations, but also the ability to participate in an informed and responsible way in the complex practical choices which face communities in the Developing Countries. If Developing Countries are to possess, or to seek to possess, this capability then they require a formal and effective system of science and technology education. The contents of that education should reflect the basic needs and existing material and human resources of that society. It would not be appropriate to provide simply a scaled-down imitation of the science and technology teaching which is to be found in the Industrialised Countries. Yet on the other hand, it would be unsatisfactory if the scientific and technological capabilities of Developing Countries failed to overlap with those of the Industrialised Countries.

Development requires, amongst other things, increasing productivity, but it should be more than that. If it is genuinely to satisfy basic needs then the details of agricultural and industrial production should reflect a careful consideration of the question: What is to be produced, for whom, and how? To make the necessary decisions a community therefore requires appropriate science, technology and education. To implement these decisions communities similarly require at least some science and quite a lot of technology. It follows therefore that a Developing Country needs to

have, or must seek to produce, people with the relevant skills. Furthermore, the skilled people have to be located within the society at the strategic points where decisions are made and implemented. This does not mean that societies should be technocracies in which decisions are solely the responsibility of scientists and technologists, but their contributions are indispensible for social and economic development.

The need for a system of science and technology education is generally recognised, but there remain complex questions about the scale of resources which should be devoted to it. After all, it can be expensive both absolutely and relatively to provide science and technology education. There are complex questions about the appropriate relationship between the teaching of science and technology and the other components of the education system; and of the relationship of science and technology education to general policies for social and economic development. There are extensive debates about what the syllabus for science and technology education should contain and what it should exclude. There is also much discussion as to who should receive that education. These questions arise particularly in relation to girls and women, to ethnic minorities, and to those living in remote rural areas, and particularly as regards nomadic communities. There are also discussions on the question of how science and technology should be taught in schools, and what should be the balance between theory and practice, classroom learning and work experience in the community.

As to scientific and technological research and development there are important debates concerning the proportion of a nation's, or a community's resources to be devoted to R & D, and what the objectives of that R & D should be. And these issues arise both for governments and for commercial enterprises.

The problem which confronts Developing Countries is not whether they should seek to rely entirely on imported technologies, or rather to rely entirely on domestically generated technologies. The question is: what sort of mix of imported and indigenously generated technologies should be sought, given the available knowledge, skills and needs?

There is almost universal agreement that the Developing Countries should not simply imitate the Industrialised Countries in their science and technology. But there is considerable disagreement when it comes to explaining why this is the case. Some commentators argue that imitation simply is not an available option; while others argue that although it may be an option it is not an economically attractive one. Yet others say that the pattern of technological development within the Industrialised Countries has been deleterious to the social and ecological interests of those countries and so Developing Countries have an opportunity to learn from the mistakes of the Industrialised Countries.

The position of science and technology in a Developing Country is, in some ways, particularly difficult. It is necessary or at least desirable that the Developing Countries have a mastery of the developments in science and technology which are occurring in the Industrialised Countries and that they develop their own science, technology and education appropriate to their distinctive needs. In other words, the demands on the scientific and technological communities in the Developing Countries are greater, perhaps both absolutely and relatively, than is the case in the Industrialised Countries.

It is now possible to assume, in this context, that there is a general recognition that Developing Countries require a system of science and technology education. Many other issues remain however to be settled. Some of the questions which arise include: what science and technology education is it possible to provide, and at what cost? Even where a country is able to quantify the extent of the resources which can be devoted to education, and more specifically to science and technology education, the problem then arises of determining what it should consist of, and how it should be provided. These problems are particularly acute for countries with very scarce resources, widely dispersed small communities in rural areas, and possibly even with inaccessible terrain, a hostile climate, and competing demands on the time and energies of children and the community at large. It is often important to ask: for whom should this education be provided? Should it be for the entire community, or just for the children? Should it be integrated into the syllabus at primary schools, or should it be confined to secondary education? How should the demands of science and technology education for children be judged by comparison with the claim on resources of, for example, an adult literacy programme, and a continuing education provision for adults. Furthermore, given that there may be fundamental practical and cultural differences between the lives of city dwellers and rural communities should this be reflected in the differences in the syllabus of science and technology education for the various communities? These are all difficult but urgent questions, yet they are not the only difficulties which need to be considered.

While it is certainly difficult to make any reliable predictions about the direction of future developments in science and technology and in the world economy, we can safely assume that there will be continual change, and that the rate of change is more likely to accelerate than to slow down. This has direct consequences for education, and especially in science and technology. In the first place, the syllabuses for science and technology need to be reviewed regularly, and revised frequently. More importantly, education should be designed to equip students not just with a grasp of current knowledge and techniques, but also the ability to continue to learn and to acquire skills during their adult lives.

Since it is generally appreciated that it is important to try to ensure that science and technology are socially relevant and appropriate, it can be important to consider how to avoid irrelevance and inappropriateness. This is especially the case since the equipment and textbooks which are most readily available are produced to service the science and technology education of the Industrialised Countries.

In all systems of education, but particularly for science and technology, it is important to determine the extent to which, and the stage at which, education should specialise into relatively narrow areas of expertise. This is a recurrent theme of debates in the Industrialised Countries, but if anything the problem is even more pressing in the Developing Countries.

Particular problems can arise if it is thought that by providing science and technology education for children a gulf will be created between the younger generations who have a knowledge of science and technology and the older generations who operate with traditional beliefs and techniques. On the one hand, science education might serve to integrate an ethnically and culturally diverse nation, yet at

the same time it might encourage divisions between the generations; or more generally between those who have and those who have not received science education. Accordingly, some communities have sought to teach science and technology in ways which integrate them (as far as is possible) with traditional beliefs and techniques, rather than in ways which supplant them.

A serious consideration of these many problems might induce some anxiety, and even discontent, with the traditional or existing forms of education. Under those circumstances it would be important to reach a realistic assessment of the extent of any possible scope for changes.

In spite of the many problems which have been outlined, it is generally recognised that it is important for science and technology education to support the goals of agricultural and industrial development, and of self-reliance. It is also often recognised that it is important to consider the extent to which science and technology education are appropriate both to the existing social and technical divisions of labour, and the changes in these which can be predicted, but these are some of the issues which are explored in Section 4.

Aiya, S.V.C., 'A School Science Project for India', Educational Development International, Vol. I, No. I, 1973, Peregrinus, U.K., pp.18-22

II A proper understanding of science and it applications is essential for future citizens of a technological society. The development of a science teaching project in India is described in relation to the constraints of scale, finance and obscurantism in which it had to take place.

Beranek, W. & Ranis, G., Science, Technology and Economic Development: A Historical and Comparative Study, Praeger, 1978

III By means of a comparison of the paths of economic development of industrialised and Developing Countries, the editors arrive at suggestions concerning the relationship between science, technology and development. Though of only passing reference to education, the book concludes that Developing Countries must exercise restraint in building up their scientific establishments and must reorientate their educational structures towards the ability to choose appropriate scientific priorities through the achievement of a broadly-based scientific literacy.

Botting, D.C., Technology in Developing Countries, Paper presented at the annual conference of the American Society for Engineering Education, 1975, available from EDRS, pp.12

II The experience of a class of students in learning about technology for development is described. The approach consisted of examining four aspects of technological transfer and impact: the colonial background, agents of change, processes of change and case studies. Central to all such courses is an analysis of the engineer's role in the process of social change and development and an examination of ways in which engineering influences the social values and institutions of society. A course outline is included.

Cooray, P.G. (ed.), Geoscience Education in Developing Countries, AGID Report No. 5, Association of Geoscientists for International Development, Dept. Geology, Memorial University, Newfoundland, Canada AIC557, 1977, pp.56

II This report is the proceedings of an international symposium on "New Developments in Earth Science Education in Developing Counties". After a brief discussion of the need for geoscience education for development abstracts of the conference papers discuss the experiences of educational programmes and institutions at tertiary level in many Developing Countries. The main themes are: regional training programmes, institutes and centres; establishment of new departments; field and practical training. Though this publication is a very practical survey of existing efforts, there is minimal consideration of the relevance of the work of geoscientists to local or regional development needs. Many of the contributors are scientists who are keen to establish themselves and their departments in the world scientific "community" and "development" is often understood in this context.

Court, D., Dilemmas of Development: The Village Polytechnic Movement as a Shadow System of Education in Kenya, Discussion Paper No. 56, Nairobi University, Kenya, 1972, pp.24, (also available from ESRS)

III One of many new alternative educational systems, Kenya's village polytechnics (low-cost training centres in rural areas) are widely perceived to be alleviating unemployment and manifesting self-help. Data are used to illustrate the movement's achievements, problems and potential in the task of national development. Its major problems lie in the pervasiveness of the ethic of formal schooling, but it has nevertheless exemplified significant new principles of education: flexibility, availability, individualism and relevance.

El Tom, M.E.A. (ed.), Developing Mathematics in Third World Countries, Amsterdam, North-Holland, 1979

II This is the report of an international seminar, almost entirely attended by nationals of Developing Countries. It considers both theoretical and practical aspects of strengthening the mathematical base in these countries so as to meet their economic and cultural needs more effectively. Much of the report is concerned with university mathematics, though there is an important section on school-level work.

English, J.M. & Collins, W.L. (eds), Educating Engineers for World Development, Proceedings of a World Congress, American Society for Engineering, Suite 400, One DuPont Circle, Washington D.C. 20036, 1975

II This was a meeting of 200 educators and administrators from thirty-seven countries, though mainly from the USA, who sought to discuss the problems of engineering education in an international context. The conference centres on the consensus that "the prerequisite for any solution is to expand intermediate and appropriate technology". Papers and discussion are presented on the role of engineering education in: agriculture/food; energy and resources development; processes of industrialisation; planning and management; human settlements; technology and culture.

Fafunwa, B.A., New Perspectives in African Education, Macmillan, Lagos, 1967

II The author's main thesis is that it is imperative for a revolution in science education to take place in Africa if the continent is to make the leap "from the eighteenth century to the twentieth century scientific age". He advocates that one third, or preferably one half, of primary school work should consist of science.

Foecke, H.A., 'Trends and Cases: Science and Technology Education for Development', Prospects: Quarterly Review of Education, Vol. 2, No.2, 1972, Paris, UNESCO, pp.221-8

III This article is adapted from a paper presented at a seminar on "Education for Rural Development in Africa". The author's opinion is that, powerful though the scientific method might be, it is not the process by which decisions are made or problems solved. He recommends an integrated programme of science and technology education incorporating what he calls "education for decision making". This is a theoretical article describing an ethos which the author would like to see running through education at all levels.

Forje, J.W., 'Science and Technology: the African Search for a Third Way to Development', in: The Perversion of Science and Technology, special issue of Alternatives, Vo. IV, No.3, 1979, Institute of World Order, 1140 Avenue of the Americas, NY 10036, pp.355-69

III Short introductory article to the role of science and technology in African development, including discussion of past and future development strategies and their relation to the changing international economic order. The author points out the problems associated with existing science and technology education in Africa.

Friere, P., Pedagogy of the Oppressed, Penguin Books, 1972

II This famous work demonstrates how education can be a powerful agent in awakening people's ability to deal with and transform the reality in which they live. Though of only oblique reference to science and technology education, the disarming ease with which the insistant logic of technological society leads people to passive conformity and consent adds further purpose to Friere's call for "genuinely liberating education".

FUNDAEC, Papers Describing a Training Programme for Engineers for Rural Welfare, Fundacion para la Aplicacion y Ensenanza de las Ciencias, Apartado Aereo 5555, Cali, Columbia

II FUNDAEC is a practical educational institute which trains agriculturalists, engineers and other professionals to work in villages and rural areas. In recent years they have created an innovative programme to train a new kind of professional, the "engineer for rural welfare". Students from rural areas are given a practical training programme to develop a wide range of technical skills that will be important in helping their communities solve their own technical problems.

Gillon, P. & Gillon, H. (eds.), Science Education in Developing Countries, Proceedings of the Fifth Rehovot Conference, Praeger, New York, 1971

II The text of this conference broadly covers the issues surrounding the role of science education in development. It presents 32 short papers on the aims of science education, children's needs and opportunities, vocational education, science teachers and teacher training and educational innovations, together with surveys of Developing Countries. The scope of this book makes it useful introductory reading, but there is little discussion of practical details nor suggestions for further reading.

Gollin, A.E., 'Foreign Study and Modernisation: The Transfer of Technology through Education', International Social Science Journal, Vol. XIX, No.3, 1967, Paris, UNESCO, pp.359-377

II Foreign study is one means of transferring technology and knowledge. Findings from an evaluation study of recipients of U.S. technical training from 29 Developing Countries are used to shed light on the transfer process. Underlying institutional arrangements emerge as significant influences upon the outcomes of this mode of inducing technological changes.

Gutelman, M. et.al., Relations Between Education and Technical Progress in Agriculture: Training of Specialists, IIEP Research Reports, no.41, 1981, Paris, UNESCO, pp.83

IV This report chooses the Sudan as a case-study in which to examine the relationships between agricultural training and technological progress in agriculture. However, its conclusions are general, the aim being to establish a framework in which future studies can take place. A distorted emphasis on academic rather than technical education, poor adaptation of knowledge to local conditions and underprovision of skilled technicians are identified amongst the major problems.

Haden, J., 'Iron and Education in Uganda', Education in Chemistry, Vol.10, No.2, 1973, The Chemical Society, Burlington House, London W1V OBN, pp.49-51

II Developments in education should not just lead to better informed and more interested pupils, but should also be powerful agents for social change. At present (1973), change is largely destructive in terms of village society. This article describes a project to involve secondary school students in Uganda in learning about the technological achievements of their traditional society.

Ikoku, C., 'The School Chemistry Curriculum and its Relevance to Society', West African Journal of Education, Vol. 7, No. 3, 1973, Institute of Education, University of Ibadan, Nigeria, pp.475-486

II This paper attempts to show how the chemistry curriculum could be more sharply focused on the realities of the Nigerian milieu and thus help to prepare students for a more meaningful and useful life in their society. It is argued that the curriculum in the secondary schools must be designed not just for the early training of the professional chemist but also to ensure the exposure of all high school students to the humanistic value of the subject and its potential for solving the nations's problems.

ILO, Education for Development, Report No.3 of the 5th African Regional Conference, ILO, Geneva, 1977, pp.103

II This report examines in detail the role of education in all its forms in facilitating the effective participation of all groups and individuals in development efforts in Africa. It gives particular attention to the poor, women and disadvantaged groups, stressing the role of non-formal education and training. Though without specific reference to science and technology, the relationships between education and technological and economic development are given thorough consideration, offering a broad framework for the discussion of the role of science education in development.

Institute of Development Studies, 'Rural Development: Whose Knowledge Counts?', Issue of the IDS BULLETIN, Vol. 10, No.2, 1979, IDS, University of Sussex, Brighton, England, pp.60

II Those with formal education and training believe that their knowledge and skills are superior, and that uneducated and untrained rural people must be ignorant and unskilled. The papers in the Bulletin challenge this orientation. They are concerned with the technical knowledge possessed by rural people and with their capabilities for assimilating, adapting, communicating and creating knowledge. An annotated bibliography for scholars is included.

International Council of Associations for Science Education, Science Education for Progress: a Caribbean Perspective, Proceedings of a regional conference in Barbados, ICASE, 1979

II Abridged versions of 28 conference papers are presented here, covering multiple aspects of science education in the Caribbean and Latin America. Issues are discussed in an essentially international context, with contributions on attitudes to and concepts of science and technology education, emphasising throughout the practical implications for the teacher and planner. A condensed source of ideas for educators in Developing Countries.

Kelly, P.J. & Schaefer, G. (eds.), Biological Education for Community Development, London, Taylor and Francis, 1980

II The meeting had four general objectives: to define the relationships between biological education and community development; to analyse the necessary content, skills and attitudes; to devise practical activities which can enable schools, teacher educational institutions and community agencies to achieve a more beneficial relationship between biological studies and community development; to define the roles of tertiary education and research in biology and suggest practical activities to foster them. Full of useful practical ideas.

Lorenz, K.M., 'Report on the First Annual Symposium of the Latin American Science Teacher's Association', Science Education, Vol. 62, No.2, 1978, John Wiley and Sons, New York, pp.249-56

II Two general themes of this conference are outlined: the importance and methods of implementing integrated science programmes and of making science curricula more relevant to students and their communities. The article describes the activities of the Brazilian Ministry of Education in trying to achieve these aims and tackle some of the country's health and agriculture problems. Schools have become involved in health improvement projects e.g. collecting and studying mathematical data on parasites affecting the community.

Maloney, T.J., 'Sensitizing Engineers and Engineering Students to Existing Local Technology Useful for Meeting Basic Human Needs', Approtech, Vol.2, No.3, 1979, University of Michigan, Ann Arbor, MI 48109, pp.1-5

II The author argues forcefully that the dominant theme in engineering education and practise of technology transfer from industrial countries has caused the existing technological base amongst the rural poor to be repressed. Such traditional technology should be considered a basic resource for development, not an impediment to it. Engineers must acquire the skills and knowledge to modify this technology and make it more effective in meeting basic human needs. The author describes his experiences in the traditional food-processing industry of Costa Rica as an example of what engineering students could learn in field exercises or classroom discussions and projects.

Moravcsik, M.J., Science Development: The Building of Science in Less Developed Countries, Publications Dept., IDRC, Indiana University, 1005 E.10th St., Bloomington, Indiana 47401, USA, 1975

II Chapter 2 of this reference (pp. 1-39) is concerned with education and science in Developing Countries. While dealing mainly with university education, much of what is said is equally relevant at school level. There is a comprehensive survey of American and Developing Country literature on science and science education in Developing Countries.

Nji, A., 'The need for Appropriate Education and Training', Approtech, Vol.2, No. 3, 1979, University of Michigan, Ann Arbor, MI 48109, pp. 10-14

II Although education in science and technology is crucial for African development, the efforts being make in this area are inadequate and often inconsistent with the actual development objectives of the African countries. The thesis of this article is that appropriate education is necessary for the development of appropriate technologies from the existing technological base. Science must be blended with practice and tradition so as to make development a self-sustaining reality.

Nyerere, J.K., 'Education for Self-Reliance', in Ujamaa: Essays on Socialism, Oxford University Press, 1968, pp.44-75

II This essay by the Tanzanian President addresses the problem of lowering the inflated status that comes with formal education and making students aware of the relation of their study to everyday life. Students should throughout their schooling participate in active life, experience working in the community and recognise their responsibility to give greater service according to the educational opportunities they have had. The solution to this problem lies not only in the educational system but in society.

Radhakrishan, S., 'Science Education and Development', in Goldsmith, M. & King, A. (eds.), Issues of Development: Towards a New Role for Science and Technology, Pergamon, 1979, pp.141-150

II Due to total lack of relationship between school and daily life, present science education patterns in Developing Countries have lead to several undesirable consequences, such as brain drain, unemployment, frustration among specially trained scientists whose work is not sufficiently challenging, and lack of commitment to the solution of social problems. This article considers questions of relevance, reform and co-operation in science education for development. It is an input to the section on Science Education and Training in this extensive and far-reaching Conference Report.

Radhakrishna, S. (ed.), Science, Technology and Global Problems: Views from the Developing World, Proceedings of a Symposium in Malaysia, Pergamon, 1980, £17.50

II A meeting of senior scientists and administrators from many Developing Countries was called to present their views to the forthcoming UN Conference on Science and Technology for Development. In an atmosphere of general dissatisfaction and disillusion with past efforts to apply science and technology in Developing Countries the working groups discussed all major aspects of science and technology and stress their crucial importance. Science education for development is approached in a highly critical and constructive manner.

Radhakrishna, S. et.al. (eds.), Technological Education and National Development, Proceedings of a COSTED-AST Workshop, COSTED, 1978

II Engineering educators from 15 Asian countries examine different methods for improving the "relevance" of science education, establishing national objectives for engineering education, developing engineering skills and restoring the "total lack of correlation between engineering and industry". The curriculum, technical education in relation to industrial and national development and the future of engineering education are discussed within the general context of Developing Countries.

Radhakrishna, S. (ed.), Science and Technology for Integrated Rural Development, proceedings of a COSTED seminar, COSTED, 1978

II Papers deal with on-going rural development programmes, future prospects and past experiences of rural development organisations in Asia. National representatives describe their experiences and stress the need for giving top priority to relevant education, population planning, appropriate technology, small-scale industry, nutrition and the satisfaction of basic human needs if meaningful development is to take place.

Ramasarma, T. et.al. (eds.), Bioscience Education in Developing Countries, proceedings of a seminar, COSTED, 1978

II Existing educational patterns in the biosciences are reviewed in order to ask how they can be modified to prepare students to use their knowledge to solve the long-standing problems faced by developing communities. Representatives of ten Developing Countries present reports of bioscience education in their countries with particular reference to areas of health, agriculture and the environment. The emphasis throughout is on the unsuitable nature of western, colonial methods and the need for social relevance in bioscience education at all levels.

Rao, K.N., 'University-Based Science and Technology for Development', Impact of Science on Society, Vol.28, No. 2, 1978, Paris, UNESCO, pp.117-125

III The author criticises the gulf between the pursuit of academic science in Developing Countries and the need for effective solutions to the urgent problems of development. He offers a host of suggestions with regard to the institutional reorganisation of university-level research and teaching needed to bring the best minds to bear on development problems, and the changes in funding and regional and international co-operation to bring this about.

Schwerin, U., The Dimensions of Technical Education, Paper presented at the Nigeria/U.S. Workshop on Technological Development in Nigeria, 1979, available from EDRS, pp.13

III The objectives of technical education are to produce technicians who not only possess the necessary skills but can also relate social values to the technical field. The most appropriate time for technical education occurs at the tertiary level in an environment reproducing the setting in which the technical skills are likely to be practiced.

Selwyn, J.B., 'Why Teach Mathematics in Lesotho?', Education in Lesotho, Vol. 1, No. 1, 1978, Institute of Education, National University of Lesotho, Roma, pp.9-13

II Criteria of economics and employment demand that all pupils should learn utilitarian methematics in a poor Developing Country. However, the author argues that a wider approach to mathematics will encourage rational understanding and develop practical skills, leading to personal development of the individual.

Shumovsky, S.A., The Planning of Technical Education in Developing Countries: Lessons from the USSR, Fundamentals of Educational Planning: Lecture-Discussion Series no.34, Paris, UNESCO(IIEP),, 1969, pp.23

II This paper discusses the relationship between economic development and education in Developing Countries, with major emphasis on the experience of the U.S.S.R. between 1917 and 1968. Sections of the paper examine the economic role of education in Developing Countries, the historical development of technological training in the U.S.S.R., the economic and educational planning process of the U.S.S.R., the training of teachers in the U.S.S.R., and some practical considerations in planning technical education in Developing Countries.

Simmons, J.L., 'Technology and Education for Economic Development', in Nader, C. & Zahlan, A.B. (eds.), Science and Technology in Developing Countries, Cambridge University Press, 1969, pp.41-59

III The first part of this paper explains the economists' interest in technology, suggesting several reasons why technology is important for economic growth and discussing difficulties involved in achieving and implementing rapid technological change. The second part reviews the literature on education as a requirement for technological development and disucsses research into methods of measuring the role of education in economic growth.

Singapore National Commission for UNESCO, Trends and Problems in Science and Technology Education in Asia, report of a regional meeting in Singapore, UNESCO Regional Office for Education in Asia, 920 Sukhumvit Road, Bankok, 1976, pp.46

II The direction of national endeavours in primary and secondary science and technology education in Asia is clearly towards making it relevant and authentic to current realities. The two main themes of this meeting were the relationship between science and technology education and community based education. Each are given brief discussion in the Report with summaries and conclusions. A concise introductory document to aims and intentions at national level, though implications for classroom practice are not extrapolated.

Thompson, K.W. & Fogel, B.R., Higher Education and Social Change: Promising Experiments in Developing Countries. Vol.I: Reports, Praeger, 1976

II An independent review of the impact of higher education on development, relying on thirty case studies by experienced educators of "successful" institutions in Africa, Asia and Latin America. Sections present the findings of the study: what needs to be done in developing rural and urban areas, improving health and creating jobs; concommitant institutional reorganisation; how to get things going; assistance and advice. The study concludes that more innovative and relevant education is needed even in "successful" institutions.

Torda, T.P., 'New Directions in Engineering Education: Suggestions for Developing Countries', in Engineering Education Today, special issue of Impact of Science on Society, Vol. 27, No. 4, 1977, UNESCO, Paris, pp.357-67

II The author describes the present situation of engineering education in the USA and describes an alternative programme for training undergraduates. In contrast to conventional curricula, the student learns to work in a group with experienced engineers, to recognise the socially significant problems, plan their solution and acquire the skills needed to solve them. The relevance of this scheme to Developing Countries is then discussed, together with the need to change traditional means of education so as to genuinely serve the goals of development.

United Nations, Science and Technology for Development: Volume VI. Education and Training, UN, New York, 1963

II The UN Conference on the Application of Science and Technology for the Benefit of Less Developed Areas took place in the third year of the first UN Development Decade. "This overall effort comprises a range of programmes aimed at increasing food production, exploiting national resources, promoting industrial development and better housing, developing science and technology and expanding international trade." This volume deals with the UN perception of the role of education in this process. At the time, "Development" was understood very much in terms of growth in national income. The reader of this report may be in a position to judge the success of the policies resulting from this approach.

UNESCO, 'Technology and General Education: Elements for a Dossier', Prospects: Quarterly Review of Education, Vol. IV, No.1, 1974, Paris, UNESCO, pp.48-115

II A UNESCO brief containing eight articles around the idea of "opening up the school system to develop in the individual and society the capacity to absorb and produce techbnology". Articles discuss the role and aims of science and technology education in Developing countries, with reference to specific experiences in Africa, Asia, Latin America and the GDR.

UNESCO, 'Technical and Vocational Education in Asia and Oceania', Bulletin of the UNESCO Regional Office for Education in Asia and Oceania, No.21, 1980, P.O. Box 1425, Bangkok G.P.O., Bangkok, Thailand, pp.316

II This issue contains a detailed regional review, a discussion of technical and vocational education in countries of Asia and Oceania, articles dealing with various aspects of technical and vocational education and a lengthy, annotated bibliographical supplement. Gives a clear idea of aims and objectives and their implementation in practice.

Vanzetti, N.R. & Bessell, J.E., 'Education and the Development of Farming in Two Areas of Zambia', Journal of Development Studies, Vol. II, No.1, 1974, Frank Cass, London, pp.41-54

III This study concludes that the main contribution of education to the improvement of farming amongst the sample was by motivating the people to improve their farming, rather than by helping them to adopt new techniques.

West African Journal of Education, 'Vocational and Technological Training in Africa', Vol. 18, No.1, Institute of Education, University of Ibadan, Nigeria, 1974

II This issue is devoted to the place of technological and vocational education in emergent African nations. Articles consider the objectives of technical education, the impact of technology on educational requirements and the practical aspects of developing curricula and educational opportunities appropriate to these realities.

Section 3b: Appropriate, alternative and intermediate technologies

It was some fifteen years ago that the concepts of appropriate and alternative technology arose. In the introduction to Section 1 there is a discussion of the social promise of science to liberate humanity from a constant struggle with the natural world to gain the basic means of subsistence. It was there explained why many people might consider that that promise has yet to be fulfilled. The central thought which underpins the concepts of alternative and appropriate technology is that the potential benefits of science for humanity can only be generally attained and enjoyed if existing technologies are used differently, and if there can be a pattern of technological development quite different from that which has occurred over much of the past two hundred years. The developments which are discussed in this sub-section therefore are at one and the same time a critique of (the use of) (some of) the existing technologies, and proposals for alternative developments.

The concept of alternative and appropriate technologies, and the critiques on which they are based, and the practical proposals for the development of new technologies, arose both in the Industrialised and the Developing Countries. These were based on the same insight, but they have slightly different meanings in the two contexts. In the Industrialised Countries it came to be seen that existing technologies, and prevailing patterns of technological development were unsuitable for a set of social innovations which were thought desirable by some analysts. In the Industrialised Countries almost everyone has access to the means of subsistence, and the concern was primarily with adjusting technologies of production to achieve social harmony and a sustainable relationship with the physical environment. On the other hand, in the Developing Countries the thought was rather that the technologies which were available from the Industrialised Countries were not meeting the basic needs of many people, and inappropriate to the development policies which many countries wished to pursue. The important difference was that in the Developing Countries people sought alternative technologies to solve current problems, while in the Industrialised Countries the concern was rather with the attainment of a future which appears more desirable to these advocates than the one to which they are currently heading.

There are several different terms involved in this discussion, and some account of their differences is doubtless in order. Historically, the first term to be introduced was 'alternative technology'. The initial idea was that a new and distinctive set of technologies should be developed which would satisfy a set of criteria, but the precise character of those technologies was rarely specified. The concept was subsequently refined, and people started to write, and talk, about 'appropriate technology'. This term is intended to be more precise and powerful than the concept of an 'alternative'. The implication was that there was not just one alternative set of technologies which satisfied those criteria which the existing technologies fail to satisfy, but that there are several different alternatives, some of which are more appropriate to a particular context than others. In other words, which technology is 'appropriate' to some context is a question not just about technology but about the social and material characteristics of that context. It is to be <u>appropriate to</u> a set of conditions rather than an <u>alternative from</u> what we already have. The concept of 'intermediate technology' is the one which was most recently introduced. The thought behind it is that the technologies which are appropriate to the basic needs of communities in the DevelopingCountries are intermediates between the high technologies of the Industrialised Countries and the pre-scientific technologies which have traditionally been used in the Developing Countries.

The important issue concerns the criteria by reference to which the appropriateness of technologies is to be judged. The specification of the criteria is connected with the substance of the criticisms which are made of the prevailing technologies of the Industrialised Countries. There are many different aspects to the critique of existing technologies, and many reasons why they might be considered inappropriate to the basic needs of the communities of the Developing Countries. Firstly, the criteria of appropriateness, and the objections to current high technologies are not merely technological or narrowly economic but fundamentally social. In the Developing Countries capital is particularly scarce, and there are many people without productive employment. Imported high technology is likely to be relatively expensive. The population is likely not to have the skills necessary to utilise or to maintain the high technology which could be imported from the Industrialised Countries, but they are likely to have traditional craft skills which need not be wasted. Energy particularly from fossil fuels is often scarce and expensive. Most Developing Countries do not yet have the systems of infrastructureal support on which many high technologies have to rely. These are just some of the considerations by reference to which the notion of 'appropriate' technology is defined. Technology is judged to be socially 'appropriate' in a Developing Country only if it contributes to the satisfaction of unmet basic needs; that is to say it is defined by reference to ends as well as means.

Other things being equal, technology is appropriate if it is available at relatively slight capital cost, is relatively labour intensive, uses relatively little energy or other scarce commodities, and relies on little in the way of infrastructural support. It should preferably utilize existing skill capabilities for production and maintenance; that is, it should provide opportunities both to use and to enhance existing skills, rather than to discard them. It should be as straightforward as possible to repair and improve the technology, and to encourage rather than stifle innovation. The effects of the use of the technology should not be to intensify the existing skewed distribution of incomes or employment opportunities. This does not mean that communities should seek to be self-sufficient in the sense of isolating themselves entirely from the world economy. But it is thought desirable for communities to attain a significant degree of self-reliance. But this can involve learning from, giving to, and trading with other communities. It is important to appreciate, moreover, that in Developing Countries the policies of national governments may have an important role to play in encouraging or inhibiting the development of appropriate technologies; and that international agencies frequently seek to play a constructive role in providing technical assistance to communities seeking to gain greater self-reliance with appropriate technologies.

The material which is contained in Section 3b discusses the nature of appropriate technologies, and generally speaking most of the authors listed there are not just describing but also advocating their use; and in many cases they seek to provide concrete and practical examples of the design and use of these alternatives. There are a few commentators who reject the idea of 'appropriate technology' altogether, and they are included here for completeness.

In this Section, alternative technologies are discussed in general terms, and also a range of specific applications are reviewed to illustrate the general themes. Amongst the items are included handbooks and manuals which are sources of technical information on specific technologies intended for practitioners of appropriate technology in the field. Five specific sectors are also examined in the final section of this bibliography and material from these different sections might usefully be read together.

Appropriate Technology, quarterly magazine, Intermediate Technology Publications Ltd., London

II "The best source of information on the work of the large number of Village Technology Research Units in Africa which have been set up .... for the purpose of developing low-cost products for the farmer and the farm household." (Ken Darrow and Rick Pam, see below.) A forum for the presentation of new technologies, ideas and appropriate technology initiatives.

Berg, L. et al., Towards Village Industry: A Strategy for Development, Intermediate Technology Publications, 1978

II Intended as a practical tool in encouraging self-reliant rural industrialisation, this book focuses on Tanzania, where government attitudes towards small-scale production have been especially helpful. Chapters describe how village industry was largely destroyed by colonialism and how it can be revived, and look at the present situation in Tanzania. The final four chapters offer an outline for anyone to design, equip and produce goods from a village workshop.

Bhagavan, M.R., A Critique of "Appropriate" Technology for Underdeveloped Countries, Research Report No. 48, Scandinavian Institute of African Studies, Uppsala, Sweden, 1979, pp.56

II Why are governments of most Developing Countries in practice not really interested in rapidly creating employment, despite the lip-service they pay to this objective? And where governments are keen, what are the forces that hinder them? From this underlying approach the author presents a strong critique of the actions of international agencies (OECD, World Bank, USAID) in promoting appropriate technology and then tries to explain the indifference of firms and governments to economically efficient, labour-intensive technologies.

Bhalla, A.S. & Stewart, F., 'International Action for Appropriate Technology', Tripartite World Conference on Employment, Income Distribution and Social Progress and the International Dvision of Labour, Background Papers, Vol. II, ILO, Geneva, 1976, pp.169-193

III Concerned with the two critical areas of international co-operation for appropriate technology: communication of known techniques and research and development of new ones. It examines regional experiences in Latin America, Africa and Asia, indicating that present efforts (1976) do not meet the requirements of a basic needs strategy.

Bhalla, A.S. (ed.), Technology and Employment in Industry: A Case Study Approach, Second, revised and enlarged edition, ILO, Geneva, 1981, £11.25

III The case studies in this volume show the economic and technical feasibility of alternative techniques. Based on field surveys, demonstrating that appropriate technology choice is not a myth. Planners and policy-makers need various instruments to help them. This book is a significant step towards an appropriate technology policy designed to develop local capability to evaluate and select from alternative options.

Bhalla, A.S., Towards Global Action for Appropriate Technology, Pergamon, 1979

III A set of essays inquiring into the kinds of international mechanisms needed to support the development of appropriate technology, conculding with a "blue-print for action" proposing a non-governmental organisation independent of, but associated with, the United Nations. Although some of the most successful appropriate technology initiatives have no national or international support, there is no discussion of possibilities for co-operation between these grass-roots schemes themselves.

Canadian Hunger Foundation, A Handbook on Appropriate Technology, Canadian Hunger Foundation, Ottawa, 1976

II Presents a brief synthesis of the theory and concepts of appropriate technology. Describes twelve well-chosen case studies of projects in Developing Countries which have been undertaken with these concepts in mind. Introduces a variety of technologies and lists individuals and groups who are working in the field.

Carr, M., Economically Appropriate Technology for Developing Countries: an Annotated Bibliography, Intermediate Technology Publications, 1976

III This bibliography is concerned with the economic aspects of intermediate technology for Developing Countries, concentrating on the hardware. The material is divided into six sections: the first four cover technologies related to the basic human needs of food, shelter, clothing, footware, energy, water supply, health and transportation; the last two contain a selection of technical publications and bibliographies which provide useful backup material to the main studies. Of greater use to scholars than to practitioners.

Carr, M., Appropriate Technology for African Women, United Nations, Addis Ababa, 1978

II Marilyn Carr points out the role of women in development and shows how important it is that appropriate technologies reach them as well as men. She presents certain technologies of prime relevance to women and describes current programmes in Africa. Includes a useful bibliography and list of contact addresses.

Darrow, K. & Pam, R., Appropriate Technology Sourcebook, Volunteers in Asia, California, 1976

II An extremely popular guide to practical books and plans for village and small community technology, reviewing in detail publications on energy, agriculture, housing, medicine, water supply, tools, approaches to appropriate technology and related subjects. "Making people aware of what has been done elsewhere is an important step in the development of locally-appropriate technology, but it should never be forgotten that local adaptation, innovation and self-reliance is the goal." In use in over 100 countries. Essential reading.

Darrow, K., Keller, K. & Pam, R., Appropriate Technology Sourcebook Vol. II, Volunteers in Asia, California, 1981

II The continuation of Volume I - 500 more publications reviewed. Includes a concise introduction to the theory and practice of appropriate technology in Developing Countries.

Dickson, D., Alternative technology and the politics of Technical Change, Fontana, 1974, Open University Text

II This book offers a searching analysis of the political role to technology in the growth of society, ultimately related to the distribution of power and the exercise of social control. It refutes the technologically determinist interpretation that social developments follow on from changes in technology and argues that the relationship between the various social groups or classes involved in the productive process become reflected in the means of production themselves, so that the social structure and the technology reinforce each other. From this point of view the book discusses the social and environmental problems associated with modern technology in developed and underdeveloped countries, in particular how these problems could be resolved through the design of alternative technology. The analysis of the theory and practice of alternative technology in the Third World highlights the impossibility of separating technological from political change.

Diwan, R. K. & Livingston, D., Alternative Development Strategies and Appropriate Technology: Science Policy for a New World Order, 1979, Pergamon, New York

Conventional development strategies (CDS) define the industrialised world as the "desired state of development" and consequently employ technologies which are capital, energy, skill and resource intensive. Alternative development strategies (ADS) emphasise local initiatives, resources and self-reliance and are most clearly associated with "appropriate" technologies. The authors examine the varied experiences of Developing Countries based on these different strategies. In conclusion they derive policies consistent with ADS and suggest areas of fruitful co-operation between Developing Countries.

Emmanuel, A., Appropriate or Underdeveloped Technology? John Wiley and Sons, 1982

III This book severely criticises the advocates of an "appropriate" technology, tailor-made to meet the needs of Developing Countries. It is the author's opinion that this is but an impoverished technology which does no more than increase their lagging behind and dependence upon Developed Countries. Writing from a technocratic Marxist viewpoint, he claims that technology transferred from rich nations is superior and that multinational corporations play a crucial supportive role. Opposite opinions are legion.

Forje, J.W., 'Women Hold the Key to Development in Africa', in Forje, J.W., The Rape of Africa at Vienna: African Participation in the 1979 UN Conference on Science and Technology for Development, ARGAD, P.O. Box 652, S-22006 Lund, Sweden, 1979, pp.89-109

II In this sharp critique of UNSCSD 1979, Forje includes a chapter in which he calls for full recognition of women's crucial role in economic and social development: "The role of women and their interests must be fully understood and incorporated in all kinds of technology transfer that enters Developing Countries." These should be technologies appropriate for women and the satisfaction of basic human needs.

Hollick, M., 'The Appropriate Technology Movement and its Literature: a Retrospective', Technology in Society, Vol. 4, No.3, 1982, Pergamon (Journals Div.), pp213-29

II By means of an examination of the literature and experiences of the appropriate technology movement, it is concluded that its goals are biased by the western emphasis on individual freedom and by the values of the western middle class.

Holtermann, S., Intermediate Technology in Ghana: The Experience of Kumasi University's Technology Consultancy Centre, Intermediate Technology Publications, 1979

II In its effort to publicise the importance of national appropriate technology centres and to show how their work can make a significant contribution to economic development, the ITDG commissioned this case study of the TCC in Ghana. The report measures the impact of government appropriate technology policies on the economy, making comparisons between intermediate and "high" technologies and their economic worth. The detailed description of the problems encountered by the TCC will be valuable for those engaged in similar projects.

Jequier, N., Intermediate Technology: A New Approach to Development Problems, OECD Observer, May-June 1975, pp.26-28

II Forerunner of Jequier (1976) explaining the essential aspects of intermediate technology, listing the major development centres and stressing the need for national educational and institutional initiatives.

Jequier, N. (ed.), Appropriate Technology: Problems and Promises, Development Centre, OECD, Paris, 1976

II Generally acknowledged to be the best introduction to the concept of appropriate technology. Part I poses the problems confronting a national innovation policy for appropriate technology. Part II presents practical experience of these problems gained in the course of varied projects in many Developing Countries.

Jequier, N., Appropriate Technology Directory, Development Centre, OECD, Paris, 1979

II The most comprehensive and up-to-date directory of "who's doing what" in the field of appropriate technology. The major organisations of 79 countries and listed here, together with their history, activities, scale, priorities, problems and publications.

Jequier. N. (ed.), 'Small is Beautiful: 10 Years On', Special Issue of Appropriate Technology, Vol.10, No.3, ITDG, 1983

II An assembly of general articles in the present state of appropriate technology, the work of various development projects, retrospectives on the last decade and priorities for the future.

Jequier, N. & Blanc, G., A World of Appropriate Technology: A Quantitative Analysis, Development Centre Studies, OECD, Paris, 1983

II This is an excellent effort to quantify the achievements of the appropriate technology movement. It assembles an impressive quantity of statistical data on growth and orgin of organisations, areas and types of activity, funding, staff and the diffusion of knowledge and information, creating a detailed picture of the development of appropriate technology worldwide. See also Whitcomb and Carr (1982).

Kaniki, M., 'Economical Technology Against Technical Efficiency in the Oil Palm Industry of West Africa', Development and Change, Vol.II, No.2, 1980, SAGE, London, pp.273-84

II This essay examines the efforts made to mechanise the oil palm industry of Nigeria and Sierra Leone during the colonial period. New mills forced on the peasants by government threatened to upset the social set-up and dislocate the family around which the traditional method of work revolved. However, technological efficiency was not a sufficient criteria for acceptance and the new mills were resisted vigorously. In conclusion, appropriate technology needs appropriate institutions which can take into account suitability, acceptability and people's means to buy the technology.

Kilby, P., 'Appropriate Technology at the National Level: a Survey', Tripartite World Conference on Employment, Income Distribution and Social Progress and the International Division of Labour, Background Papers, Vol. I, ILO, Geneva, 1976, pp.107-119

III Concerned mainly with an empirical review of what individual countries have done in their efforts to develop and disseminate appropriate technologies. Drawing upon this experience, a concluding secion summarises those policy measures which seem to hold the greatest promise for effecting the desired changes.

MacPherson, G.A., First Steps in Village Mechanisation, Tanzania Publishing House, Dar es Salaam, 1975

II A very useful handbook written for co-operatives and ujamaa villages starting with virtually nothing except people and the things that they find around them. It gives step by step instructions on producing workshop equipment and tools, village transport, agricultural equipment, training of donkeys and oxen and management of co-operative workshops. The author places great emphasis on self-reliance and people's involvement in solving technological problems in their environment.

Macpherson, G. & Jackson, D., 'Village Technology for Rural Development: Agricultural Innovation in Tanzania', International Labour Review, Vol.III, No.2, 1975, ILO, Geneva, pp.97-118

II The authors describe and analyse a project to improve the tools most appropriate to the needs and environmental and economic constraints of the small-scale subsistance farmer. Relative costs are compared and detailed data on suitable implements given. The economic soundness of "village technology" is demonstrated by a case study of supplying water to a village in Northern Tanzania. It concludes with the consideration of a need for a "hierarchy" of technologies in which to base projects for rural development.

McRobie, G., Small is Possible, Jonathan Cape, London, 1981

II This book is intended as a sequel to Schumacher's early work to demonstrate how the concepts of appropriate technology can and have been successfully adopted. In part I the author describes in detail the achievements of the Intermediate Technology Development Group and its continuing work today, arguing that industrialised nations are now as much in need of appropriate technology as Developing Countries. Part II surveys the burgeoning movements in the U.K., U.S.A. and Canada. In the extensive supplement the author goes on to describe the pioneering work of appropriate technology groups in Developing Countries.

Melanesian Council of Churches, Likluk Buk - A Rural Development Handbook/Catalogue for Papua New Guinea, Wantok Publications, Boroko, Papua New Guinea, 1977

II An excellent example of what a national catalogue/handbook can be. Likluk Buk contains a wealth of information for rural development in Papua New Guinea, listing who's doing what and how, and where to go for further information. Of particular value throughout Southeast Asia and other tropical countries.

Mitchell, R. J. (ed.), Experiences in Appropriate Technology, Canadian Hunger Foundation, 1980

II "Appropriate Technology succeeds or fails in application at the local level, not in scientific research and development institutions." In this sequel to the Handbook, case studies are presnted which question the current practice of appropriate technology in Developing Countries, demonstrating that as much emphasis must be placed on developing strong decentralised organisations which can choose and implement the hardware as on developing the hardware.

Open University, Choosing Appropriate Technology, Control of Technology Units 15-16, Open University Press, 1978

III These final two units of the "Control of Technology" Course have four aims: to develop the idea of choosing technologies to serve human and social needs; to give practical examples in Developing Countries; to show that constraints on technological choice are not only technical but organisational, institutional and political; to gain new perspectives from which to reflect on questions of control of technology as a whole.

Perkins, D. et.al., Rural Small-Scale Industry in the People's Republic of China, University of California Press, 2223 Fulton St., Berkeley, CA, 1977

II Much can be learned from the remarkable success of the Chinese efforts to develop grass roots skills and innovative capability, and improve the general standard of living through promotion of rural small-scale industry. The authors of this report discuss the administrative systems, worker incentives, economies associated with small-scale industries, the relationship between these industries and agriculture, and their impact on Chinese society.

Robinson, A. (ed.), Appropriate Technologies for Third World Economic Development, Proceedings of a Conference held by the International Economic Association at Tehran, Macmillan, London, 1979

III The purpose of this meeting of economists and government officials was to ask: "How are in the actual practice of current development are "appropriate technologies" being used? And if not, why not?" Papers discuss the experiences of industrialisation in Developing Countries, analysing the social, economic and technical obstacles to the use of appropriate technologies. The environmentalist viewpoint that technologies should be consistent with the ecology of rural life as well as with the socio-economic structures of rural societies raised wider issues in the discussion. The role of multinationals in technology transfer and the role of international aid also featured. An interesting contrast to the literature of the "grass-roots" appropriate technology movements.

Schumacher, E. F., Small is Beautiful: A Study of Economics as if People Mattered, London, Blond and Briggs, 1973

II The book that inspired the movement for appropriate technology. Written by the founder of the Intermediate Technology Development Group. Schumacher looks at the problems of production economics in the modern world and the question of size. After considering the world resources situation he approaches the problems facing the Third World and calls for the development of an "intermediate technology". In the final chapter he proposes the new patterns of ownership and organisation needed to facilitate the introduction of a "technology with a human face".

Timmer, C.P. et.al., The Choice of Technology in Developing Countries: Some Cautionary Tales, Centre for International Affairs, Harvard University, 1975

II Four specialists focus on one of the most intractable problems facing many Developing Countries - unemployment. The preferred technology used early in the industrialisation process - modelled on that of the advanced countries - is capital intensive. This book draws on four case-studies to show why an intermediate technology using less capital and more labour may be part of the answer to the unemployment problem.

United Nations Children's Fund, Village Technology in Eastern Africa, UNICEF, 1976 (available from ITDG)

II Here is an excellent introductory book, relevant to most Developing Countries. It includes a review of the basic concepts of appropriate technology and an overview of potential tools and techniques for agriculture, food prepartation and preservation and water supply. Criteria for evaluating rural energy needs and affordable solutions are presented.

van Ginniken, W. & Baron, C. (eds.), Appropriate Products, Employment and Technology: Case-Studies on Consumer Choice and Basic Needs in Developing Countries, Macmillan, London, 1984

III This collection adds a new dimension to the study of appropriate technology by considering consumer behaviour. It concludes that low-income consumers buy appropriate products and services in an efficient manner, where they are available. They also patronise small-scale enterprises, thus generating considerable employment. One important policy implication of the work is that more sustained government support to small-scale and rural industries might itself lead to an increased demand for relatively labour-intensive products.

de Veen, J. J., The Rural Access Roads Programme: Appropriate Technology in Kenya, ILO, Geneva, 1980

III Describes the setting-up of what has become one of the largest and most successful labour-based road construction programmes of past decades. Provides a straightforward account of the organisation, design and control of projects, labour recruitment and training, offering explanation of procedures and sensible advice. Essential reading for anyone likely to be involved in labour-based construction projects.

Volger, J., Work from Waste: Recycling Wastes to Create Employment, Intermediate Technology Publications, 1981

II This unique handbook brings together details of appropriate technologies which can be used to recycle all manner of materials and create employment in Developing Countries. Part I details the wide range of materials which can be recycled and the processes involved. Part II describes how to set up a small business recycling wastes.

Volunteers for International Technical Assistance, Village Technology Handbook, VITA, Maryland, USA, 1970

II This handbook was conceived in 1962 as a means of bridging the technical information gap which keeps the world's villages from learning from one another's experience. The book's aim is to gather in one publication information from many sources which has been found to be helpful in villages. Experience has shown this handbook to be extremely valuable.

Whitcombe, R. & Carr, M., Appropriate Technology Institutions: A Review, ITDG Occasional Papers No. 7, ITDG, 1981, pp.74

II In recent years ITDG has received an increasing number of requests for information, advice and assistance of an institutional as opposed to a purely technical nature. This study is an important step towards this objective. Its purpose is to review, classify and analyse the experience gained in the establishment and operation of appropriate technology institutions, and to identify strengths and weaknesses, achievements and problems, purposes and objectives. A valuable analytical counterpart to Jequier and Blanc (1983).

Section 4:

Consequences of the application of science based technological innovations

Developing Countries are trying to develop suffiently rapidly to provide the most impoverished sections of their population with a reasonable hope of a decent standard of living in their foreseeable future. Given the urgency of many of the problems of Developing Countries and the fact that their resources are severely limited, then it is important to give some serious consideration to the consequences of technological changes in production both at home and abroad. In particular, it is important to consider the consequences of technological changes not just in regard to the commodities which are produced, but also in relation to the technologies used in production.

Quite a lot of work during the last ten years has been devoted to an examination of the social organisation of production, and the ways in which people and technologies interact. This interaction between people and machinery is now generally termed the 'labour process'. The organisation of the labour process has been reviewed by reference to at least two sets of considerations. In the first place attention has been given to the optimal arrangement of material and human resources, to maximise productivity and minimise waste of scarce resources; but on the other hand it has also been generally considered that it is important to enquire into the consequences, and the social meaning, of the organisation of production for those directly involved in that work. One can for instance examine whether or not the skills which workers possess are being effectively deployed and developed, or whether demands are being made on them which they do not have the skills to meet.

The skills which can be deployed in any productive enterprise are limited obviously by the skills which are available in the community, and that depends both on competing demands, and on programmes of education and training. In relation to the creation and utilization of skills communities face both immediate problems and future challenges. They might ask: what skills do we now possess and require? And, what skills shall we require if we take particular decisions? This latter question can then lead on to asking: are there the necessary motivation, training, and supports to make these skills available? In turn this raises questions about both the school system, and on-the-job training for those who have left school. It also raises questions about the provision of continuing education and training for those who are neither at school nor in employment, such as married women and especially mothers, who also require an ability to cope with future technological changes.

There is at least one point on which there appears to be unanimity, and that is that science and technology education (and indeed education in general) should equip pupils with the ability to cope with rapidly changing future circumstances. We can be certain that the least likely future would be one in which science and technology do not change rapidly. As a consequence, appropriate science and technology education must be such as to assist pupils to achieve flexibility and a continuing capacity to learn as new ideas, products and processes arise. One might say therefore that an education which is appropriate for this day and age would be such that it must be appropriate not merely for the present day but also for the future. Imagination, creativity and flexibility have therefore become more important objectives of education than merely the ability to ensure that pupils can reliably perform a fixed and determinate repertoire of procedures or actions.

Section 4a: The consequences of the application of science based technological innovations for the world of work, the scale and composition of the labour markets

During the 1970's there developed a set of discussions in the Industrialised Countries concerning the social impact of technological change in production. This was not just about production levels, productivity and prices, but more particularly concerned the personnel directly engaged in production. These issues have been explored only recently in relation to the Developing Countries. It is not that these issues had been entirely neglected previously, but rather that they had been examined from a rather narrow perspective, namely from that of management science. It is generally recognised that much of the pioneering work in this field was accomplished by Braverman. Braverman maintains that science had been applied to the study of the labour process in the sense that (at least) since the work of F.W. Taylor, the labour process has been examined quantitatively and empirically; but that Scientific Management (as Taylor termed it) was an irredeemably partial approach since it reflected a particular sectional interest to the neglect of the concerns of others.

According to Braverman, Scientific Management was a project of appropriating from the skilled craft workers their knowledge so that it could either be replaced by science-based production technology, and/or subject to a formal system of management discipline. In so far as the skilled workers have a monopoly (or even a near-monopoly) of technological knowledge then they can and will resist the imposition of production targets and work rates. Industrial management since Taylor has, at least in the Industrialised Countries, sought to reduce or if possible eliminate any reliance on craft skills, and where ever possible to replace them with machinery. This process Braverman and others call 'deskilling'. Deskilling involves rendering traditional skills redundant and changing the skill requirements of production. Furthermore, industrial managers have sought to achieve a sharp distinction between those who design and direct production from those who execute those decisions.

Work in this field has served in part to provide an account of the resistance of some groups (particularly skilled workers) to technological changes, and it has variously been interpreted as having implications for alternative ways of organising production so as to gain the maximum benefit from the skills of the work force, and as pointing to ways of introducing new technologies with as little social friction as possible.

This type of analysis of the labour process has subsequently been extended to a consideration of production in the Developing Countries, but to a lesser extent. Indeed it is perhaps worth adding that work in this area is distinctly patchy in relation to the Industrialised Countries, where the majority of the attention has been paid to the consequences of the introduction of microelectronic technology into production; and as regards the Developing Countries the surface had barely been scratched. Hopefully, however, there is here an opportunity for the Developing Countries to learn from the experience and mistakes of the Industrialised Countries and not merely to repeat them.

As the technology of production changes there are inevitably changes both in the size and skill characteristics of the labour force. There is a great deal of debate in the Industrialised Countries concerning the extent to which technological changes must bear the responsibility for the great increase in industrial unemployment which has occurred in recent years. Unemployment due to technological change and the displacement of skilled personnel is termed 'structural employment'. There is a group

of commentators who see the bulk of current unemployment as technologically determined and structural. The remedy which they would seek would also have to be structural, although not necessarily technological. On the other hand, there is another school of thought which argues that technology has been displacing skills at a fairly steady rate ever since the 1780's, but that periodically technological changes have called forth a whole range of new skills and thereby provided a whole range of new employment possibilities. The current depression in employment is therefore explained by this group in different terms. This school of thought tends to ascribe the responsibility for causing and for curing unemployment to governments, or to other social groups which are resisting the introduction of new technologies which have the capacity to provide new employment opportunities. Some commentators think that we are moving into a post-industrial society in which overall levels of employment will be low, and that the distribution of commodities will be determined other than through wage incomes. Others expect that a new wave of technological developments will create again a substantial demand for both skilled and unskilled labour.

Whatever the size of labour markets will be in the future, it is at any rate certain that the skills in demand are likely to be very different from those which historically have been important.

Quite a lot of attention has been given to the distribution of employment between different goups, and different regions of the globe. At an early stage of the development of a new product or process the demand on the labour force tends to be quite extensive, both as regards the size and the skill composition of the labour force. As the technology matures however, and process innovations are incorporated into the production process, the skill requirements and even the size of the work force tend to fall. An example can be found in the electronics industry. In the early phase of this industry it employed quite a lot of skilled people. As the industry grew it came to employ a larger number of people but requiring fewer skills. It was at this stage that many electronics companies established production in Developing Countries to take advantage of a plentiful supply of cheap unskilled or semi-skilled workers. Subsequently the production of electronic products has itself become automated, and the comparative advantage of production in Developing Countries has diminished, and it has become more important to locate production close to the final markets. This illustrates how during the life time of an industry the size and composition of its labour force can change, and some of the reasons why it might be relocated in different parts of the world.

One of the main issues which underlies the topics which are discussed in this section is the division of labour. There is an international division of labour, as well as divisions of labour within nations and states, within corporations and within industries, and within productive units, between the sexes and within families. The technology and the division of labour are dependent variables. The division of labour is, in part, a reflection of the distribution of knowledge and skills. There is therefore a connection between technology and society. This does not mean that they are entirely congruent or harmoniously related but they are cetainly not independent of each other. That much is perhaps a matter of consensus but there are extensive and at times heated debates about how labour should be apportioned and divided, and how it should be organised, and what technologies should be utilised.

Baron, C., Energy, Employment and Basic Needs: The Social Implications of Energy Scarcity in Developing Countries, University of Rotterdam, Centre for Development Planning, Discussion Paper No. 53, Rotterdam, 1980

II This literature review sets out to describe the energy situation in the medium and long-term from the point of view of Developing Countries, and to define the policy choices in the field of energy supply, taking into account social objectives such as the generation of productive employment and the eradication of poverty.

Baron, C.G. (ed.), Technology, Employment and Basic Needs in Food Processing in Developing Countries, a study prepared for the ILO within the framework of the World Employment Programme, Pergamon, 1980

III An empirical investigation into appropriate industrial technologies - technologies which are more employment generating but technically and economically efficient. Largely by means of detailed case studies, technologies of food processing are examined here, together with policy implications to encourage the application of appropriate technologies for the satisfaction of basic needs.

Braverman, H., Labor and Monopoly Capital, Monthy Review Press, 1974

II This crucial book is a systematic enquiry into the consequences of technological change for the nature of work and the composition of labour markets. It comprehensively analyses the effects of automation on workers' autonomy and on their control of the production process. In cataloguing the demise of craftsmanship in capitalist industry, Braverman draws upon a lifetime's experience as a craftsman and finally exposes the widely-held belief that technological change has increased demand for skilled labour.

Dauber, R. & Cain, M.L.(eds.), Women and Technological Change in Developing Countries, Westview Press Inc., 1981

III This collection of essays considers areas of development - health, food, housing and fertility - that concern women in their roles within the family and as wage earners. It assesses their specific needs both in adapting to technological change and as agents of that change. The three sections look at women's role in development, case studies of the effects on their work of new technologies and finally the implications for policy. Brings together a wide variety of experience in research and in the field.

Ernst, D., 'International Transfer of Technology, Technological Dependence and Underdevelopment: key issues', in Ernst, D. (ed.), The New International Division of Labour, Technology and Underdevelopment: Consequences for the Third World, Campus Verlay, 1980, pp.15-75

II This chapter is a readable introduction to the main issues addressed by the title, aimed not just at policy makers but at teachers, journalists and those active in issues of technology in society. Amongst others it covers: the worldwide internationalisation of capital pioneered by the multinational corportations; technical co-operation amongst Developing Countries; self-reliance; the new international economic order and the role of the industrialised nations in assisting development. The general issues raised in this introduction are expanded at length in the rest of this major work.

Ernst, D., Restructuring World Industry in a Period of Crisis - The Role of Innovation: An Analysis of Recent Developments in the Semiconductor Industry, UNIDO Working Paper on Structural Change, Vienna, UNIDO, 1981

IV This very important study examines how recent developments in the micro-electronics industry will affect the economics of semiconductor manufacture, corporate structure and strategy and ultimately the international restructuring of the industry. From the experience of the semiconductor industry the author draws some tentative conclusions concerning global patterns of technological dominance and dependence and the theory of international industrial restructuring in a period of crisis.

Friedrichs, G. & Schaff, A. (eds.), Microelectronics and Society: For Better or Worse: A Report to the Club of Rome, Pergamon, 1982

II In a straightforward and readable manner this report sets out the problems and opportunities associated with the new technology. The reader is introduced to the history and nature of microelectronics. Its applications are discussed together with the social and economic considerations from the points of view of management and worker. The Report then broadens to embrace discussion of the implications for the Third World, for future war, political control and international relations. No suggestions for further reading are given.

Frobel, F., Heinrichs, J., Keye, O., The New International Division of Labour: Structural Employment in Industrialised Countries and Industrialisation in Developing Countries, Cambridge University Press, 1980

IV The massive shift of capital investment from the North to the low-cost production sites of the South, and the subsequent world market oriented industrialisation of Developing Countries, has reinforced the historical process of underdevelopment, unemployment and dependency. The study presents exhaustive empirical evidence in support of this thesis.

Garmany, J.W., 'Technology and Employment in Developing Countries', Journal of Modern African Studies, Vol. 16, No. 4, 1978, Cambridge University Press, pp.549-64

III This article introduces the issues involved in the choice of technology in Developing Countries, especially those in Africa, and their relationship to employment and output. It outlines the problems associated with choice of products and techniques, the use of resources, scarcity of foreign exchange, skill shortage, labour surplus and the divide between the urban and rural populations. Tentative conclusions are drawn for government policy.

Gill, G.J., 'Mechanised Land Preparation, Productivity and Employment in Bangladesh', Journal of Development Studies, Vol.19, No.3, 1983, Frank Cass, London, pp.329-348

II This paper presents a synopsis of the findings of a recent intensive survey in Bangladesh which concluded that mechanisation of land preparation makes little or no difference to land productivity, but does cause substantial direct and indirect labour displacement.

Grossman, R., Women's Place in the Integrated Circuit, Pacific Research, Vol.9, No.5/6, 1978, 222B View St., Mountain Veiw, CA 94041, USA

II This article points out the links between the conventional ways in which multinational corporations exploit the Developing Countries and the new forms of domination based on the sexual division of labour. Semiconductor industry personnel policies are designed to divert attention from pay and working conditions by stressing female stereotypes and superficial consumption.

Hoffman, K., Rush, H., Microelectronics and the Third World: The Emerging Issues, SPRU Occasional Paper, Science Policy Research Unit, University of Sussex, U.K., 1980

II This paper is seen by the authors as a largely speculative "attempt to pose questions rather than to answer them as a means of broadening what has thus far been a vociferous though limited debate." It catalogues the applications and discusses in general terms the economic and industrial impact of microelectronics technology on the Third World.

International Labour Office, Automation in Developing Countries, ILO, Geneva, 1972

II How can Developing Countries cope with the tremendous output-raising (but labour-replacing) capacity of automation? Must they accept the widening technology gap between Developed and Developing Countries? Or can they adapt the new technology selectively, without a disproportionate loss of jobs, harsh training problems, rising inequality and social conflict? Seven general analyses and six case studies illustrate these questions.

International Labour Organisation, Mechanisation and Employment in Agriculture: Case Studies from Four Continents, ILO, Geneva, 1973

III Will the mechanisation of agriculture in the Developing Countries lead to more or less productive employment on the land? This is a quantitative study of the effects of the "Green Revolution" and conseqent mechanisation of the scale of employment, drawing conclusions for future policy.

International Labour Organisation, Technology to Improve Working Conditions in Asia, ILO, Geneva, 1979

III Papers prepared between 1975 and 1977 for the 1977 National Tripartite Conference on Improving Working Conditions and Environment held in the Phillipines. Presents preliminary research into the relationships between the various aspects of technology, offering a conceptual framework, identification of specific problem areas and a programme for action. Though focussed on Asia, undoubtedly relevant to other regions.

International Labour Organisation, Employment Effects of Multinational Enterprises in Developing Countries, ILO, Geneva, 1981

III The report analyses foreign investment and the direct employment effects (volume, distribution and structure) of multinationals in the Developing Countries of Africa, Asia and Latin America. Indirect employment effects (on national income and revenue, suppliers, other enterprises) are also discussed. A chapter is devoted to multinationals in Free Trade Zones. Finally, the report highlights government policies and technology choice by multinationals as important inter-related determinants of their employment effects.

Jacobsson, S., 'Microelectronics and the Third World: An argument against Labour Intensive Technologies', Wireless World, Vol.86, No.1531, March 1980, I.P.C. Electrical--Electronic Press Ltd., pp.87-89

II Shortened version of Jacobsson (1979).

Jacobsson, S. & Sigurdson, J. (eds.), Technological Trends and Challenges in Electronics, Research Policy Institute, University of Lund, Sweden, 1983

II This book brings together a number of detailed case studies that analyse the likely effects of the new electronics technologies on Developing Countries. Chapters deal with their impact on engineering, garment and computer industries, others with the potential of computer-aided-design and machine tools. A concluding chapter discusses the lessons to be drawn from such analyses for indistrial strategies in the Developing Countries.

Jacobsson, S., 'Technical Change, Employment and Distribution in Less Developed Countries', The Lund Letter on Science, Technology and Basic Human Needs, Notes on Preparation for the 1979 United Nations Conference on Science and Technology for Development, University of Lund, Sweden, 1979

III This special report provides a critique of the appropriate technology "solution" to er.ployment problems in the Developing Countries, namely that they would largely be solved by developing labour intensive technologies in the manufacturing sector. It argues that there are strong institutional limitations to such technologies, and that were they to be overcome, the vast majority of the labour force would still have to be employed in other sectors.

Kaplinsky, R. (ed.), 'Comparative Advantage in an Automating World', IDS Bulletin, Vol.13, No.2, March 1982, Institute of Development Studies, University of Sussex, Brighton, U.K.

II This issue of the IDS Bulleting presents a collection of short articles from eight of the major contributors to this growing debate.

Kaplinsky, R., 'Microelectronics and the Third World', Third World Issue, Radical Science Journal No. 10, 1980, Russell Press, U.K., pp.37-51

III The early part of this article is based on Kaplinsky (1980a). Looks also at the effects of microelectronics on comparative advantage, concluding that multi-national corporations are less likely to locate in low labour-cost countries. See also Levidow (1980).

Kaplinsky, R., Computer-Aided Design: Electronics, Comparative Advantage and Development, (UNIDO), London, Frances Pinter, 1982

III Although this sectional study comprises an analysis of the specific origins, developments and uses of CAD technology as a sector in its own right, it more importantly illuminates general aspects of the origins and diffusion of electronics technologies, the benefits arising from their use and their effect on the international division of labour.

Kaplinsky, R., Automation: The Technology and Society, Longman, 1983

II This very important work is essential reading for anyone wishing to understand the interplay of technology with society. Writing from a resolutely historical approach, Kaplinsky extends his earlier work to cover design, manufacture and co-ordination in full recognition of the social, economic and behavioural forces affecting automation. Later chapters include impact on labour and on the Third World.

Levidow, L., 'Notes on Development', Third World Issue, Radical Science Journal No. 10, 1980, Russell Press, U.K., pp.53-63

III In this article Les Levidow is highly critical of the usual approach to issues of Third World development. He points out the dangers of the euphemistic jargon that obscures the true relations of domination between First and Third Worlds. He argues that the whole "development" debate is really about adapting Third World countries to more effective exploitation by imperialism, smoothing out the restructuring of the international division of labour to more fully complement exploitation in the imperialist countries themselves. In conclusion, Levidow applies these pungent criticisms to the article by Kaplinsky (1980) in this issue.

Levidow, L. & Young, B. (eds.), Science, Technology and the Labour Process, Marxist Studies Vol. I, Blackrose Press, London, 1981

III "While capitalist development has tended to increase the productivity of living labour, it has also re-organised the labour process to overcome worker insubordination". This book attempts to integrate the analysis of science and technology with Marxist critiques of the capitalist mode of production. The first three chapters look at general features of the role of science and technology in production. The final three provide detailed case studies in the areas of microelectronics, biotechnology and photographic processing in the industrialised West.

Morehouse, W. & Chopra, R., Chicken and Egg: Electronics and Social Change in India, Technology and Culture Occasional Report Series No.10, University of Lund Research Policy Institute, Sweden, 1983, pp.100

II "Socioeconomic institutions and cultural values obviously play the decisive role in determining what kinds of technologies are developed and how they are used. But technological change itself opens up new options for societies that certainly influence the character of socioeconomic change." This paper looks at contemporary manufacturing and the applications of electronics, its potential impact on social change. Government policy and performance are also discussed.

Nihei, Y. et al., Technology, Employment Practices and Workers: A Comparative Study of Ten Cotton Spinning Plants in Five Asian Countries, University of Hong Kong, Centre for Asian Studies, 1979

IV This study sets out to make up for the dearth of substantial empirical work on the impact of industrialisation on the Developing Countries of Asia. A team of interdisciplinary researchers investigates the interrelationships between owners, management workers and technology within the theoretical framework of a "convergence" of original cultural distinctions towards identical social, political and economic institutions brought about by industrialisation.

North American Council on Latin America, 'Electronics: The Global Industry', NACLA's Latin America and Empire Report, Vol. XI, No. 4, April 1977, 151 W.19th St., 9th Fl., New York, NY 10011, USA

II Although it is now assumed that there is a declining tendency for high technology industries to "run away" to countries with low-cost labour supplies, this report was compiled when the practice was commonplace. Articles discuss the susceptibility of the electronics industry to "run-aways", look at their production practices in Asia and suggest strategies for their control.

Rada, J.F., The Impact of Microelectronics and Information Technology: Case-Studies in Latin America, UNESCO, Paris, 1982

II The case studies of Brazil and Argentia conclude that: electronics is becoming a "convergence" industry as most industrial sectors come to depend upon it; cheap labour is no longer so necessary in the industry, reducing the comparative advantage of Developing Countries; the greater reliance on science will increase the development gap; impact on employment must be anticipated by more education; Developing Countries have the potential to produce high-quality, cheap software (computer programmes); they must ensure that the use of this technology is directed towards their own needs, or levels of cultural dependence will increase.

Rada, J., The Impact of Microelectronics: A Tentative Appraisal of Information Technology, International Labour Office, Geneva, 1980

II This study is one of the first to extend the current debate on the socio-economic effects of the new microelectronic technology to incude effects on Developing Countries and the new international division of labour. The book outlines the nature and characteristics of the technology and describes the global development of the microelectronics industry. It looks in some detail at its present applications in the service and industrial sectors of the advanced economies and considers the effects on Developing Countries in terms of employment and income distribution, making particular reference to textile manufacturing and the electronics industry.

Schmitz, H., Technology and Employment Practices: Industrial Labour Processes in Developing Countries, Research Report, Institute of Development Studies, University of Sussex, Brighton, U.K., Mimeo, 1983

III Examines the ways in which technology influences employers' policies of labour utilization in the formal sector of Developing Countries. Part 1 reviews the literature, Part 2 presents an empirical investigation based on factory visits and interviews with management and unions in four Brazilian industries. Part 3 draws out the implications of the findings for Developing Countries in general.

Sen, A., Employment, Technology and Development: A Study Prepared for the ILO Within the Framework of the World Employment Programme, Clarendon Press, U.K., 1975

III This seminal work by the professor of political economy at Oxford University, England, is concerned with presenting an approach to technological choice as a part of employment policy in Developing Countries. The focus is on the use of existing knowledge through appropriate institutional and incentives structures and pricing policies regarding factor inputs and products. In summary: "One of the most significant conclusions of the study is that economic policies, if formulated in isolation from the specific political, social and institutional context, are almost bound to flounder. These non-economic constraints are of fundamental importance for employment policy."

Shaiken, H., Computer Technology and the Relations of Power in the Workplace, International Institute for Comparative Social Research, Steinplatz 2, D 1000 Berlin 12, FRG, pp.71

III "Microelectronics makes possible a form of automation that is as flexible as previous forms were unyielding. Instead of capturing skill in steel, the knowledge to produce a part is stored in computer memories, and the production of a new type of part requires only new instructions instead of new machines. This flexibility not only extends automation to a wide range of new occuptations and workplaces, but makes possible a thorough reorganisation of any workplace in which it is applied."

Siegel, L., 'Delicate Bonds: The Global Semiconductor Industry', Pacific Research, Vol.II, No.1,, 1980, 222B View St., Mountain View, CA 94041, USA

II This special issue of Pacific Reseach presents a comprehensive examination of the U.S. semiconductor industry. It traces the rise of the silicon chip and details the aggressive expansion of U.S. corporations into the cheap labour markets of Asia, examining the effects of production processes on the workers' environment both in and outside the factory.

Sivanandan, A., 'Imperialism and Disorganic Development in the Silicon Age', Race and Class, Vol.XXI, No.2, Autumn 1979, Institute of Race Relations, 247 Pentonville Rd., London N1

II Traces the tendency of capital to migrate to sources of cheap labour, encouraged by the revolutionary technological changes in the production process. However, capitalist development outside the industrialised nations has not been accompanied by concurrent development of a capitalist culture or political order. As a result, the populations of Developing Countries face compounded poverty, cultural corruption and social disintegration.

Tinker, I., New Technologies for Food Chain Activities: the Imperative of Equity for Women, Agency for International Development, Washington D.C., 1979, pp.43

II "Women's traditional economic contribution to the survival of their families is being eroded by technology. Without income, the woman cannot afford new technologies. Without time, the woman cannot try her hand at new economic activities. This vicious circle must be broken." This essay examines the impact to technology on women in the Developing Countries of the World, suggesting alternative technologies and criteria for their introduction.

Section 4b: The consequences of the application of science based technological innovations for education, skills and training

In the introduction to Section 4a it was pointed out that the demand for skills can fluctuate rapidly, particularly when there are rapid changes in technology. The skills which are scarce and precious this year may become plentiful or unnecessary in a few years' time. It is not possible to separate decisions about the technology and organisation or production from decisions about the provision of education and skill training.

A community cannot utilize skills which are not available and it is pointless to train people to acquire skills for which there is, or will be, no demand. The problem for most communities is that of obtaining an optimal match between that which education supplies and that which production and employment require. The problem is particularly difficult since there is a continuing need to relate together two things which are each constantly changing. Communities do not face the relatively simple matter of subordinating education to the staffing requirements of commerce, industry and the state, or of determining the technology of production and the division of labour by reference to the characteristics of the education system. But it is a continuing matter of revising both in the light of the ever changing needs and possibilities of the others, in the context of the local, national, regional and global economy. It is difficult to overemphasise the importance and the difficulties here involved.

Acero, L., 'Worker's Skills in Latin America: an Approach Towards Self-Reliant Development', Development and Change, Vol. II, No.3, 1980, London, SAGE, pp.367-89

III The aim of this paper is to suggest the kind of skills needed by manual workers in Developing Countries which are engaged in a process of self-reliant development. The first part of the paper looks at skills and the control of labour in dependent (as opposed to self-reliant) societies. The second looks at how these skills are produced by the scientific and educational systems. The final section of the analysis draws up a definition of the nature of skills for self-reliance.

Acero, L., Impact of Technical Change on Traditional Skills: The Textiles Sector in Brazil, International Development Research Centre, Instituto Universitario de Pesquisa, Rio de Janeiro, Brazil, 1982

III This empirical investigation of recent modernisation in the Brazilian textile industry details the relationship between technological change, skills and the social and sexual divisions of labour in a newly industrialising country. In contrast to much literature in this field the study also examines the experience of technological change as perceived by the factory workers. (Submitted in revised form to University of Sussex for D. Phil. degree, 1983.)

Adiseshiah, M.S., 'Future Asian Education', in Avakov, R.M. (ed.), The Future of Education and the Education of the Future, Paris, IIEP, 1980, pp.269-80

II Major educational policies in Asia are critically examined. The author stresses the need for a shift in the direction of Indian education towards relevance to future skill needs associated with labour-intensive agricultural technologies. The problems of the educated unemployed and the mismatch between educational output and demand are discussed, together with the dangers of a formal education policy geared to the tiny proportion of the population employed in the non-industrial modern sector.

Anderson, L., 'Multinational Corporations and Educational Relevance in Developing Countries', in Anderson, L. & Windham, D.M. (eds.), Education and Development: Issues in the Analysis and Planning of Postcolonial Societies, Lexington Books, 1978 pp.75-98

III When the rate of technological change becomes imposed, as for example, by the sudden introduction of technologies of production that bear little resemblance to the needs of the developing economy, the relationship between the educational system and the economy is strained. This original chapter draws attention to the tendencies of multinationals in two areas - factor utilization and technology transfer - and looks at the effects they have on educational relevance. Implications for educational planning are discussed.

Antrobus, P. & Rogers, B., 'Hanover Street: an Experiment to train Women in Welding and Carpentry', Seeds (unnumbered), Carnegie Corporation of New York, 1980, pp.16

II One in a series of short pamphlets describing self-help projects for women in the Caribbean, this edition presents the experience of the Jamaican Women's Bureau in developing a skills training programme to provide low-income women with a better means of earning a living. The lessons from this experiment show that income-generating projects for and by women are viable and have an important role to play in development.

Barker, C.E. et.al., 'Impact of Technology on the Build-Up of Technical Skills', in Barker, C.E. et.al., Industrial Production and Transfer of Technology in Tanzania, University of Dar-es-Salaam, Institute of Development Studies, 1974-5, Chap. III.3, pp.80

III This chapter reveals the impact of imported technology on the development of the forces and relations of production in the industrial enterprise. Emphasis is placed on technical skill build-up by means of formal technological education and on-site training. The study confirms that the technical development which in advanced capitalist society has lead to an intensification of the division between mental and manual work has lead to the incorporation of Tanzania, like other Developing Countries, into the international division of labour.

Blaug, M., Education and the Employment Problem in Developing Countries, 3rd Impression, ILO, Geneva, 1978, pp.89

II This popular monograph addresses itself to three major concerns: to what extent are educational authorities responsible for the employment problem in Developing Countries? Does the quality and quantity of education make a significant impact on employment? If so how can educational systems be reformed so as to maximise the rate of growth of income-earning opportunities? The key questions raised in this lucid study remain largely unsolved.

Boserup, E., Women's Role in Economic Development, St. Martin's Press, New York, 1970

II Seminal work on the role of women in economic development in Developing Countries. "Economic and social development unavoidably entails the disintegration of the division of labour among the sexes traditionally established in the village. With modernisation of agriculture and with migration to the towns, a new sex pattern of productive work must emerge, for better or worse." Having established these propositions using available data, the author draws conclusions for female education policy.

Bowman, M. J., 'From Guilds to Infant Training Industries', in Anderson C.A. & Bowman, A.J. (Eds.), Education and Economic Development, Frank Cass, 1966, pp.98-129

III Through a discussion of schooling and apprenticeships in pre-industrial England and America, the author analyses the relation of education to the industrial future. She then looks at the ways in which skills are transferred and propagated in the process of development, discussing how migrant industries could be used as means for training the indiginous population. The study provokes ideas for the creation of opportunities for skill acquisition through job-linked training and experience.

Carr, M., Developing Small-Scale Industries in India: an Integrated Approach, Intermediate Technology Publications, 1981

II The Birla Institute of Technology has shown that it is possible for a university to promote technically advanced independent small businesses. This book presents case studies and evaluations of enterprises established through the Institute's programme. Far from being a blue-print for further action, it is a source of ideas for those responsible for technical training and the promotion of rural industrialisation and development.

Carr, M. N., 'Simple Technologies for Villages in Africa: A Review of the Village Technology Programme of the Training and Research Centre for Women', Paper presented at the Conference on the Effective Use of Appropriate Technologies, Indianapolis, 1977 (available from ITDG, London)

II Describes how the African Training and Research Centre for women of the UN Economic Commission for Africa seeks to assist governments with programmes and projects aimed at introducing village technologies to rural women and describes some of the difficulties involved.

Commonwealth Secretariat, Technical Education and Industry: 2, Report of a Commonwealth Regional Seminar in Nigeria, Commonwealth Secretariat, Marlborough House, London SW1Y 5HX, 1979, pp.102

II This seminar intended to assist commonwealth countries of Africa in making technical education more relevant to their needs. The proceedings consist of 4 papers and ensuing discussion: the apprenticeship system and national policies; the partnership between educational institutes and industry in Britain; technical education in an industrialising country; commonwealth co-operation in technical education. The final recommendations are for action at the level of government.

Cooley, M., Architect or Bee? The Human/Technology Relationship, Langley Technical Services, 95 Sussex Place, Slough, England, 1980

II This work is based on twenty years experience as an industrial designer in the U.K. The author's analysis springs from the idea that a society's technology is an integral part of its politics, and that present technological systems are used for purposes of political control by the multinational corporations. He uses the example of the computer to illustrate the problems that advanced technology as a whole is bringing with it. The book includes a description of the Lucas Aerospace Corporate Plan to turn the tide of production towards socially responsible systems and socially useful products.

Coombs, P.H. & Manzoor, A., Attacking Rural Poverty: How Non-Formal Education Can Help, John Hopkins University Press, 1974

II Given that the main thrust of development efforts has centred on modernisation of urban areas, this major study aims to develop practical guidelines useful to those involved in planning, evaluating and implementing programmes of non-formal education geared to rural development. Its scope is confined mainly to programmes designed to increase rural employment, productivity and income through improving the knowledge and skills of farmers, rural artisans and craft workers, and small entrepreneurs.

Council for Science and Society, New Technology, Employment and Skill, Blackrose Press, London, 1981

II This Report concludes that the effects of the new technology will be most profound in their influence upon work. Problems of unemployment, job fragmentation, satisfaction and skill are approached from a wide range of personal and social viewpoints. Through a critical and historical analysis of automation and the division of labour, the report recommends a redirection of technological development enabling a fuller use of people's abilities and skills.

Deforge, Y., 'Systems of Knowledge Production and Acquisition', Prospects: Quarterly Review of Education, Vol. IX, No.1, 1979, UNESCO, Paris, pp.3-21

II The author's line or argument is that mechanisation of production leads to a systematic division of labour and a hierarchical stratification of tasks. Vocational training becomes class education designed to enable the skilled worker to take his/her place in the established structure. Almost any educational system will suffice to supply this structure with technicians. But if its objectives are concerned with a more egalitarian society, with encouraging responsible, autonomous citizens, basic training for the students must go beyond the production situation confronting them.

Dore, R.P., The Diploma Disease: Education, Qualification and Development, Allen and Unwin, London, 1976

II In many countries in the developing world, school education is dominated by a pre-occupation with obtaining paper qualifications. The competetive scramble for scarce jobs in the modern sector causes a distorted use of educational resources which could be far better employed in the cause of promoting development. Though having only incidental relevance to science and technology, this book is an important survey of the social pressures which constrain the way in which these subjects are taught.

Duplex, J. et.al., 'Employment and Training in Metallurgical Industries in the Department of the Bouches du Rhone, France', Education, Work and Employment I, UNESCO, International Institute for Educational Planning, Paris, 1980, pp.259-320

III This study of diploma training for sheet-metal workers in a small area of France illustrates the authors' hypothesis that industry plays an important role in structuring the educational system. The relations between the two are the result of social processes specific to each society. The wide variety of ways in which training is acquired and the way in which it is used and recognised are given detailed examination. It is concluded that the organisation of the firm and its technical requirements combine with workers' orientation and training in the educational system to result in a detailed division of labour and a complex hierarchy of skill qualifications.

Fretwell, D.H., Technology Transfer and Vocational Teacher Training in Developing Countries, Paper presented at the Annual Convention of the American Vocational Association, 1981, available from ESRS, pp.11

III Many Developing Countries are looking to "competency-based individualised instruction" (CBII) as a method of enhancing vocational training programmes and facilitating technology transfer from developed nations. This largely overcomes the economic and political obstacles to importing instructors from abroad. The author claims that while there are major problems in implementing CBII, its benefits are flexibility, cost-effectiveness, standardized format, objectivity and direct relevance to job requirements.

Gonod, P.F., Integrating the Planning of Education and Technology, IIEP Research Reports No. 42, International Institute for Educational Planning, UNESCO, Paris, 1981, pp.124

IV This study is an attempt at the construction of a model of the relationship between the educational and technological systems. Analysis of their characteristics reveal various types of relationship. The aim is to ascertain the basic conditions for planning and therefore to define an approach to the problems of planning education and training in Developing Countries in relation to technological progress. Concludes with criticisms of current UN activities and offers proposals for a large-scale research programme.

Hoffman, K. and Rush, R., 'Microelectronics, Industry and the Third World', Futures, Vol.12, No.4, 1980, Butterworth Scientific Ltd., pp.289-302

II Looking briefly at the textile, footwear, garment and electronics industries, the authors discuss the consequences and call for government intervention to ensure the acquisition of software skills to make full use of the new technology.

International Centre for Research on Women, Bringing Women In: Towards a New Direction in Occupational Skills Training for Women, ICRW, 1010 16th Street, N.W., 3rd Fl., Washington D.C. 20036, 1980, pp.34

III Part 1 of this report deals with the rationale for training women in occupational skills in Developing Countries. Part 2 looks at the constraints that women face in obtaining and making use of this training. In part 3 a brief disucssion addresses concerns within the U.S. Agency for International Development regarding employment on income-generating skills and highlights implications for women. Focuses on skill needs of rural and urban poor women in Developing Countries with little or no primary schooling.

International Labour Organisation, The Impact of Multinational Enterprises on Employment and Training, ILO, Geneva, 1976, pp.33

II The multinationals more or less directly improve technical training and educational standards in the host country by training their production personnel with the aid of a slightly different programme from the one used by local firms. Opportunities for local people to attain managerial positions depend on the "maturity" of the multinational, the degree of standardisation of the technology employed and on the obligations imposed by the host country.

International Labour Organisation, Technology, Employment and Basic Needs, ILO Overview Paper prepared for the United Nations Conference on Science and Technology for Development, Fourth impression, I.L.O., Geneva, 1979

II This paper is a definitive statement of the I.L.O. position regarding appropriate technology for development, its adopted policies and its role in assisting research and training.

International Labour Organisation, Multinationals' Training Practices and Development, ILO, Geneva, 1981

III This study is an up-to-date examination of the training practices of multinational enterprises and of the developmental effects of this training, resulting from a programme of research commissioned by the ILO. It consists of a review of the literature, examples of multinational training practices and case studies of their impact on development in India, Nigeria and Brazil.

King, K., 'Skill Acquisition in the Informal Sector of an African Economy: the Kenya Case', Journal of Development Studies, Vol. II, No.2, 1975, Frank Cass, London, pp.108-122

II Many thousnads of Africans arrange types of unofficial fee-paying apprenticeships at the feet of older, often illiterate craftsmen. The process represents an indiginisation in Kenya of important elements of East African Indian craft training and has considerable implications for the success of the government's official formal sector apprenticeship schemes, in which the tendency is to have technical "qualifications" without industrial or workshop experience.

King, K., The African Artisan, Heineman, London, 1977

II Upon a background of growing disillusion in the seventies with formal education and training in Africa, this book analyses the acquisition of technical skills through "informal", out-of-school means in the villages, towns and cities of Kenya. It describes both the formal and informal education sectors and makes a close study of two examples of small-scale, indiginous manufacturing in order to investigate the skills and technologies employed by untrained artisans, and the ways in which formal education could be reoriented towards their needs. The survey concludes that a better understanding of the relationship between informal and formal sectors would give greater coherence to educational planning. Finally the Kenyan experience is contrasted with other African countries.

King, K., 'Education and Self-Employment', Education, Work and Employment II, UNESCO, International Institute for Educational Planning, Paris, 1980, pp.217-83

III The author reviews some of the most recent developments in the area of education for self-employment in Developing Countries: school vocationalisation; formalisation of village technology; schools as production units; diversification of schools and education for youth and the community. Using a detailed analysis of the nature of work undertaken by the self-employed, the author shows how entry to the complex system of self-employment is very much related to the functions of the existing educational system, formal and non-formal.

Kutsch, G., Technical Co-operation Among Developing Countries (TCDC): What Does It Mean For Education Towards a New International Economic Order (NIEO)? Report Study No.55B, Division of Educational Policy and Planning, UNESCO, Paris, 1978, pp.34

II The concept of the TCDC has evolved since the early 1970's in the thinking of the U.N. to mean that science and technology are crucial to the establishment of a NIEO. The author argues that this limited concept is, through its straightforward context, in danger of substituting the general political aims of the NIEO. The barriers to technological development are political, not vice-versa. Further issues such as the satisfaction of basic needs are in danger of being relegated to secondary importance by this technical solution. Implications for education are discussed.

MacPherson, G., First Steps in Village Modernisation, Tanzania Publishing House, 1975

II This is a handbook designed to assist village development workers in African villages in helping people acquire self-reliant technological capabilities. It assumes that a village is chosen that has little or no technical knowledge and describes the process of training through the use of practical work projects. Concerned also with training the new craftsperson to become an entrepreneur.

Nazre-Hyder, S., Technology and Skill-Formation: the Chinese Experience 1953-75, Islamabad Papers No.3, Institute of Strategic Studies, Islamabad, 1978, pp.24

II The outcome of the Chinese strategy for technology and skill formation is discussed in general terms. Though the Chinese model cannot be treated as a prototype for other Developing Countries, its significance lies in the questions it raises about the relationship of these assets to the development process. Perhaps the most important lessons lie in China's use of agricultural technologies to support industrialisation and in using its scientific resources to retain flexibility and freedom from foreign interference.

Peitchinis, S.G., The Effect of Technological Change on Education and Skill Requirements of Industry, Research Report, University of Calgary, Alberta, Canada, 1978, pp.272

IV Considers the impact of technological change on the sectional distribution of employment in Canada and discusses the problem of determining the effects of technological change on education and skill requirements. The report concludes that employees seem able to adjust to new work processes and that organisations assist this through retraining programmes. However, future changes may be more dramatic and require a larger increase in technical knowledge. A large and well annotated bibliography is included.

Reiffers, J.-L., et.al., Transnational Corporations and Endogenous Development: Effects on Culture, Communication, Education, and Science and Technology, UNESCO, Paris, 1982

IV This extremely comprehensive study takes the view that "Just as TNCs represent the organisational model which local firms try to imitate in order to achieve the same efficiency, so their professional staff, usually trained abroad, represent the new elite with which students compare themselves, whether they accept this model or oppose it. Thus TNCs activate, and at the same time modify, both the demand for labour from local firms, which try by means of fresh recruitment to transform their management methods, and the demand for education from the middle classes, who see possible opportunities for social mobility."

Simmons, J., The Education Dilemma: Policy Issues for Developing Countries in the 1980's, Oxford, Pergamon, 1980

III This book questions the adequacy of the western European and North American Modes of formal schooling when applied to Developing Countries. Should a country continue to expand expensive secondary and higher education, or should it divert resources to the relatively cheap primary and non-formal sectors? "Also a greater match is required between educational product and the employers' needs." He includes examples of schemes in which such an approach has been followed, but considers most countries to have held back because those in control wish to maintain the present power structure.

Stewart, F. & James, J. (eds.), The Economics of New Technology in Developing Countries, London, Frances Pinter, 1982; America, West View Press, 1982

III This set of essays introduces the new concern of research into technology in Developing Countries with the changing perspectives on technology over time. Section I examines criteria for technical choice and selection mechanisms. Sections II and III look at the different aspects of building up technological capacity: technical mastery, learning and the accumulation of experience.

Swords-Isherwood, N. & Senker, P. (eds.), Microelectronics and the Engineering Industry: the need for skills, London, Frances Pinter, 1980

II In the absence of work of this kind focused on Developing Countries, this book is the culmination of a decade of research into the ways in which the industrialised nations will have to adapt the education and training of their work force to meet the demands of microelectronics. This is accomplished by means of the thorough investigation of skill requirements in different sectors of the mechanical engineering industry in the United Kingdom.

Tedesco, J.C., 'Education and Employment: the Case of the Industrial Sector in Argentina', Prospects: Quarterly Review of Education, Vol. IX, No.1, 1979, Paris, UNESCO, pp.105-113

II This case study considers the changing role of education in relation to employment. The author points out the dangers "of specific training to the hindrance of mobility and to an increased likelihood of unemployment due to technological obsolescence". Educational policy strategies are discussed briefly in this light.

UNESCO, International Conference on the Education and Training of Engineers and Higher Technicians, held in New Delhi, Final Report, UNESCO, 1976, pp.36 plus annex

II This report is a precis of the conference. It reviews the problems related to estimation of qualified man/womanpower needed in engineering; curriculum design and evaluation; continuing education; education-industry interaction; educational institutions and co-operation. Of most interest to the teacher of planner are the detailed conclusions and recommendations to the above agenda items.

Whiston, T., Senker, P., & Macdonald, P., An Annotated Bibliography on the Relationship between Technological Change and Educational Development, UNESCO, International Institute for Educational Planning, Paris, 1980

II The compilers of this concise yet comprehensive bibliography have aimed at providing a balanced sample of recent publications which address themselves both to questions of "education" and "technological change" in the same paper. Four aspects have guided the choice of material for inclusion: the implications of technological change for educational policy; the consequences of educational policies for technology; the general interaction between both areas and lastly the specific area of educational technology. The bibliography covers articles raising broad social and political issues and also those articles leaning towards more specific areas of technology. It has been compiled with attention to issues of concern to both Industrialised and Developing Countries.

Whiston, T.G., 'The Development of Education: its Technological and Social Dimensions', in Avakov, R.M. (ed.), The Future of Education and the Education of the Future, UNESCO, Paris, 1980, pp.319-60

III The focus of this discussion paper is to attempt to highlight the major educational policy dilemmas and requirements of both developed and developing nations and their technological and social dimensions. The implications of present and future technological innovation for educationalists are outlined and the different educational requirements of labour-intensive and capital intensive strategies for Developing Countries are discussed.

Section 5:
Science and technology and the satisfaction of basic needs and social goals

If science and technology are socially relevant in any context then they must at least contribute to the satisfaction of basic but unmet personal and social needs. These obviously include at least the provision of an adequate food supply, and decent housing and health care, and a sustainable relationship to the physical environment.

To the early advocates of the scientific and industrial revolutions it was axiomatic that the manifest lack of adequate food and housing etc. were obviously the result of problems of material scarcity. It was no less axiomatic therefore that science and technology could provide invaluable and indispensible help in solving these problems. As Jonathan Swift said: "... whoever could make two blades of grass to grow upon a spot of ground where only one grew before, would .... do more essential service to his country than the whole race of politicians put together."

Science and technology have been applied successfully to raising the productivity of labour in agriculture, they have also made possible great reductions in the rates of infant mortality, raised average lifespans, and improved the technologies of building and house construction. In point of fact, the productivity of labour in agriculture in the Industrialised Countries has risen so rapidly that over the last one hundred and fifty years, labour productivity in agriculture has been rising faster on average than productivity in any other major industrial sector, with the possible exception of the electronics industry in the past five years. As a result, the Industrialised Countries are struggling with the problem of food surpluses and inadequate market demand. Nonetheless, the majority of communities and people in the Developing Countries continue to live without satisfactory access to the means by which to meet their basic needs. It might therefore seem obvious that the continued application of science and industrial technology will be necessary, and maybe even sufficient, to satisfy these so far unmet needs. A central question therefore is precisely: what is the social and economic relevance of science and technology in the Developing Countries in relation to the satisfaction of their basic needs?

There is no general consensus in the answers given to these questions, or rather there is a spectrum of opinions, but with identifiable groups clustered each around their own particular consensus. At one extreme there are those who argue that these problems are entirely technological problems for which there are, or can be, purely technological solutions and that no social changes are required. At the other extreme, there are those who believe that the problems are not fundamentally material or technological at all, but they are essentially social and economic, and that technology is either socially neutral and therefore irrelevant, or just part of the problem rather than part of the solution. Between these extremes there are those who recognise that the provision of the means to satisfy basic needs for all humanity required innovations both in social relations and in both science and technology.

This is Section Five, and it is divided into five sub-sections, but similar issues arise in each case, and more importantly the issues are all interconnected. As a result, the form of the questions which arise in each of the sub-sections are more or less constant but the details of the answers vary from case to case. Accordingly, all the sub-sections will be introduced at this point, but one at a time.

Section 5a: Food production, processing and distribution

The provision of an adequate supply of nutritious food to all human beings is evidently not solely a technological problem admitting of a technological solution. This is evident since the United Nations Food and Agriculture Organisation provides us with data to show that in aggregate there is more than sufficient food in the world for everyone. But, it is not evenly distributed, much is lost in storage, and massive quantitites of foods are reprocessed up the food chain to provide meat based diets in the Industrialised Countries. At the same time, the Industrialised Countries are selling their surplus crops, and value-added processed products, in the markets of the Developing Countries. Hungry people, however, are poor people who cannot afford current market prices. All of this implies that the problems of hunger and malnutrition of the Developing Countries are not solely technological problems for which purely technological solutions can be provided.

This conclusion is reinforced by an examination of the impact of advanced science-based agricultural technology on hunger in the Developing Countries. There is a broadly based consensus which has determined that the Green Revolution did not solve, and in some ways, exacerbated the problems of hunger and malnutrition. The 'Green Revolution' is the term used to refer to the introduction of new varieties of grains which are highly responsive to chemical fertilizers, given suitable conditions of irrigation and cultivation. The social impact of these new technologies were profound but paradoxical. On the one hand, where the new varieties could be cultivated in optimal conditions the total agricultural harvest increased, yet consequently at the same time the absolute number of hungry people increased too. This was primarily because the technology had differential impacts on different groups, and brought about increased social inequalities, and thereby lowered the material standard of living of the poorest groups, and so aggravated their difficulties. While that much is a matter of general consensus there is much dispute about the potential relevance of these new technologies to satisfaction of basic needs. Some argue that they are irrelevant, some that they are more of a hindrance than a help, and yet others that they promise enormous benefits, but only given appropriate innovations in social relations such as land reform..

The potential risks and benefits of food processing and food additive technologies for the people of the Developing Countries are debated along almost identical lines. While there is much debate about the benefits of food technologies in the Developing Countries, it is generally recognised that it would be beneficial if scientific nutritional knowledge were more widely available in both the Developing and the Industrialised Countries.

On balance, the majority of commentators take the view that science and technology are of massive potential benefit in relation to the provision of adequate food supplies to all communities, but they differ over the social conditions for the realisation of that potential.

Section 5b: Population levels

This topic is probably the most contentious issue which is dealt with in this bibliography, and the focus of a long standing and bitter debate. To a decent first approximation the protagonists in this debate can be divided into two groups which argue for and against the Malthusian position. This derives from the work of Thomas Malthus (1766-1834) who was the founder of that school of thought which sees hunger and poverty as inevitable consequences of the tension between rapidly expanding levels of population and only gradual improvements in agricultural production. While the Malthusians see population levels in Developing Countries as the central cause of hunger, poverty and under-development, the anti-Malthusians argue that the large size of poor families is a consequence of poverty and is a rational response from those with few, or no other resources than their children. Accordingly, one side of the argument insists that population growth rates must be cut before poverty can be cured, while the other side argues that social reforms which will diminish or eliminate poverty will spontaneously lead to a reduction and stabilization of family size. There is also an important debate about the empirical basis of the Malthusian debates since there is some evidence which suggests that aggregate agricultural production has been rising faster than population size even though the number of hungry people has grown too. This stark division is also reflected in opinions concerning the social meaning of contraceptive technologies. For some commentators contraceptive technology is a means for the oppression of poor people, and especially poor women; while for others it provides a wonderful opportunity to liberate women from recurrent pregnancies, and a means of liberating communities from the burden of too many mouths to feed. Few commentators would argue that people should not have access to technologies which can provide them with control over their fertility, but there is an immense debate about the social conditions under which the potential benefits of the technology can be obtained.

Section 5c: Housing

During the 1960's R. Buckminster Fûller argued that "The answer to the housing problem lies on the way to the moon". By this he was taken to be suggesting that the housing problem is essentially a technological problem which requires a technological solution. The idea was that as the research programme of space exploration proceeds, new materials and new construction techniques will be invented and that these can be adapted for and applied to the construction of low-cost high-performance housing on earth. In the Industrialised Countries there have been substantial advances in the manufacture of the components for housing, and in the methods of their assembly on-site, but there remains an extensive debate about the extent to which these technological changes contribute to a solution of the problems of sub-standard and inadequate housing provision. In relation to the Developing Countries this debate is, if anything, even more intense. On the one hand technological optimists emphasise the cost-saving benefits of high-technology house production, while on the other hand some commentators argue that poor housing is not a consequence of any lack of land or building technology. Most people recognise that there is significant scope for improvements in house building technologies, but there is an important set of debates about the social conditions under which these benefits may be generally available so that basic needs for appropriate housing can be met. There is an influential school of thought which contends that housing needs can most effectively be met by relying on the indigenous skills and resources of the Developing Countires rather than by importing high technology construction systems from the Industrialised Countries.

Section 5d: Health care

Medical science and technology can undoubtedly be of enormous actual or potential benefit throughout the globe. Some technologies though are extremely expensive and Developing Countries with severely restricted budgets need to give very careful consideration to the priorities for health care expenditures. There is an influential school of thought which argues that the technologies of prevention are a far more effective investment than technologies to treat or to cure people who have succumbed to illness. Obviously, standards of diet, nutrition and housing are important determinants of mortality and morbidity. The availability of a reliable and safe water supply are of unquestionable importance. Many commentators in the Industrialised Countries maintain that the decline of major infectious diseases in their societeis was at least as much due to the installation of proper systems of main drains as to the production and distribution of antibiotic drugs. It is evident that the communities of the Developing Countries are suffering from health, and health-related, problems which are both more acute and more chronic than those in the Industrialised Countries. Very careful consideration therefore has to be given to a determination of the most appropriate health care technologies and the social conditions under which the potential benefits can be realised.

Section 5e: The Environment

There is no doubt that it is impossible to industrialise or to modernise any society without changing the physical environment. The question at issue is rather what kind of industrial development is it possible and desirable to obtain which does not irretrievably damage the environment in a way which is unacceptable either locally or globally. There are important discussions on how to determine the costs and benefits of industrialisation, how they are to be compared, and how they are to be distributed. For example, there are debates as to whether the costs of pollution should be born directly by the polluter, or by the general community or specifically by the consumers of the products responsible. There are important debates about the role of the state, and of international agencies, in conservation and pollution control. There is a particular concern to examine the ways in which the Developing Countries can harness their own scientific and technological capabilities to deal with these problems. Science and technology in industry can be used both creatively and destructively; and the central question again is: under what social conditions can the benefits be maximised and the harm be minimised?

Abalu, G.O.I., 'Solving Africa's food problem', in Food Policy, Vol. 7, No.3, Aug. 1982, IPC Business Press, Guildford, U.K., pp.247-56

II Since Africa is particularly likely to be vulnerable to food problems in the next decade, this paper focuses on major similarities, and differences, between African countries as regards their social, economic and agricultural conditions and policies. Low agricultural productivity, high and increasing levels of poverty are highlighted, and policies to remedy these problems are proposed making special reference to the need for self-reliant technological changes.

The Agricultural Consulting Bureau for the Tropics, The Ecological Methods, 1976, ACBT, Ranonkelstraat 19, The Hague, The Netherlands

II Practical proposals for ecologically sound methods of agriculture appropriate to tropical conditions intended to maintain and improve the delicate character of soils, by combining a variety of moisture retaining and otherwise bio-active plants. The publishers request a "donation" of only one U.S. dollar and give free advice by post on questions of organic farming in Developing Countries.

Almeida, S. et.al., 'Assessment of The World Food Situation - Present and Future', International Journal of Health Services, Vol. 5, No.1, 1975, Baywood Publishing Company, pp.95-120

II This article is based on part one of World Hunger: Causes and Remedies, prepared by the Transnational Institute for the United Nations World Food Conference in Rome, November 1974. It reviews the crisis of food, supplies and prices in the mid-1970's, and patterns of trade and stock-holding. It examines patterns of food production and consumption globally, and presents data on population, food supply and demand for 33 Industrialised Countries, and for 96 Developing Countries. It reviews likely changes which are to be expected without major changes of policy, and briefly discusses desirable new policies.

Anderson, R.S. et.al. (Eds.), Science, Politics, and the Agricultural Revolution in Asia, Westview Press, Boulder, Colorado, for the American Association for the Advancement of Science, 1982, £30.25

IV This book is based on a symposium held in 1980 at an A.A.A.S. meeting in San Francisco. The papers in this volume review the experiences of farmers in Asia with commercial agriculture and they examine the role of reseach institutions in fostering commercial farming. They take a critical look at the emphasis on the introduction of new technologies, and explore alternative approaches to productive agriculture and rural development.

Berg, A., & Muscat, R., 'Nutrition and Development: the View of the Planner', American Journal of Clinical Nutrition, Vol. 25, 1972, 9650 Rockville Pike, Bethesda, MD, U.S.A., pp.186-209

II An outline of the social, economic, medical and educational consequences of malnutrition in Developing Countries, and the benefits which would follow a solution to problems of hunger and malnutrition.

Berry, R. A. & Cline, W.R., Agrarian Structure and Productivity in Developing Countries - A Study Prepared for the ILO within the Framework of the World Employment Programme, John Hopkins UP, 1979

III This study deals with a fundamental question for any policy of agrarian reform, namely the relationship between farm size and the productivity of land, labour and capital. The authors assembled data from six major Developing Countries: Brazil, Colombia, the Philippines, Pakistan, India and Malaysia. They conclude that small farms make better use of the available land than do large farms. Furthermore, small farms achieve higher rates of multiple cropping and they cultivate a higher proportion of total land. The results of this study therefore imply that policies for agricultural development should focus on helping small farms in preference to large farms.

Borgstrom, G., The Hungry Planet, The Modern World At The Edge of Famine, first published by Collier & Macmillan in 1967, but updated, revised and republished in 1972 by Collier-Macmillan, New York

II A powerful statement of the view that human population growth is causing and will continue to cause increasing mass starvatiuon. This book contains a great deal of quantitiative data on production, demand, and comsumption. All parts of the global economy are reviewed, as are a wide range of potential sources of food.

Borgstrom, G., World Food Resources, Intext Educational, New York & London, 1973

II A direct statement of the view that humanity faces a crisis of a scarcity of food given current population size and rates of growth. It surveys food sources and the material conditions for food production, and the limits on production. It then reviews the transformation by processing of raw foods into marketable food products, and then considers patterns of food trade. The final section examines human nutritional needs, and the relations between nutrition and health with particular emphasis on protein requirements. The author calls for major changes in policy to remedy the perceived problems.

de Castro, J., The Geopolitics of Hunger, Monthly Review Press, New York & London, 1977; originally published as The Geography of Hunger, but revised and enlarged in 1973

II Hunger is here described as an inevitable consequence of under-development. The author argues that hunger is a man-made plague, and that starvation causes over-population, and not the reverse. There is an extensive description of the regional distribution of hunger with special emphasis on Central and South America, but also a discussion of Asia and Africa. The contribution which science can make to the elimination of hunger is discussed as well as the limits on that contribution. The conclusion discusses policy changes necessary for progress towards the elimination of hunger.

Cathie, J., The Political Economy of Food Aid, Gower Publishing Co., 1982

III Since its origins in the years immediately following the Second World War, food aid has become a permanent and integral feature of international development aid programmes. During this period international policy on the production and disposal of agricultural surpluses has been a mixture of both rationalised political expediency and humanitarian compassion. This study seeks to describe and analyse the major issues concerning the often conflicting interests of donor and recipient nations concerned with food aid, and the roles of multilateral food aid agencies.

Clairmonte, F.F., 'Bananas', Chapter 6 of Commodity Trade of the Third World, Payne, C. (Ed.), Macmillan, London, 1975, pp.129-153

II A detailed empirical treatment of the distribution of costs and incomes in the production of bananas in Developing Countries for sale in the Industrialised Countries.

Clark, J. Milking Whom? A Study of Europe's Leading Agricultural Sector and Its Effects on European and Third World Food Systems, International Coalition for Development Action, Bedford Chambers, Covent Garden, London, 1979

II A clear, dense and powerful pamphlet on the effects of the Common Agricultural Policy of the European Economic Community upon food and agriculture in Developing Countries. The discussion concentrates on the dairy sector and the contribution of dairy food to EEC food aid to Developing Countries. The general conclusion is that the EEC food policy is harmful both for many European consumers, and for people in Developing Countries.

Dinham, B., & Himes, C., Agribusiness in Africa, Earth Reseach Res., 1983

II They provide a detailed analysis of the impact of big business on African agriculture, and several examples of company activities, trade and investment in cash-crops for non-African markets. They explore comparatively Tanzanian and Kenyan government policies in relation to increasing dependency and the extension of large-scale, foreign owned agribusiness schemes.

Douglas, J. Sholto & Hart,-R. de J., Forest Farming, Conservation Tools and Technology, 143 Maple Road, Surbiton, Surrey, KT6 4BH, England

II On the cultivation of trees as a contribution to the progress of the rural economy in Developing Countries; and it contains detailed practical advice and information on various species, the use of their products for food and raw materials, their cultivation and ecology.

Dumont, R. & Cohen, N., The Growth of Hunger: A New Politics of Agriculture, Marion Boyars, London & Boston, 1980

II The authors of this brief and accessible text seek to provide the reasons for chronic hunger and acute famines. They detail the roles played by the Industrialised Countries, and their effects upon the Developing Countries. The policies of relatively cheap food for their populations pursued by the Industrial Countries is presented as inhibiting the production of essential foods which are required if poorer nations are to feed their own people. The authors argue that the Industrial Countries are imposing inappropriate forms of agricultural production and distribution upon Developing Countries, and they advocate profound changes of policy.

Epstein, T. S., Urban Food Marketing and Third World Rural Development: The Structure of Producer-Seller Markets, Croom Helm, London, 1982, £13.95

IV Based on a study of Papua New Guinea, the authoress explores the nature of food marketing in Third World Countries, particularly the phenomenon of urban producer-seller markets. She argues that a hierarchically structured food marketing system is only likely to develop in those countries which have a strong and centralised political administration. The book argues that countries which are ethnically diverse and diffusely organised should not seek to establish a central marketing system, but seek to rely on a localised webbed system with producers selling their own food directly to consumers.

George, S., How the Other Half Dies: The Real Reasons for World Hunger, Pelican Books, London, 1976

II This book describes the political and economic forces which shape the lives of people in Developing Countries and which determine if, how much, and when, they will eat. The authoress argues that mass hunger is not a natural or inevitable feature of this world, but a human artefact. She shows that there is, in aggregate, sufficient food in the world for everyone and that over-population is not the cause of mass hunger. She argues on the contrary that the problem for the market is a surpulus of food, relative to effective demand if not to real needs. She describes in particular the roles of multinational corporations and food aid programmes in creating and exacerbating the problems.

George, S. & Paige, N., Food for Beginners, Writers and Readers Publishing Co-operative, 144 Camden High Street, London NW1 0NE, England, 1982, £2.50

II A simple introduction to problems of food and hunger from a global perspective, comprehensively illustrated with pictures and cartoons. It locates the problem of mass hunger in a historical perspective and relates it to colonialism and imperialism and their consequences. It deals with hunger as an effect of the unequal distribution of power within and between nations.

Gilmore, R., A Poor Harvest: The Clash of Policies and Interests in the Grain Trade, Londman, New York & London, o982

III The agriculture of the United States, and some other leading Industrialised Countries, is faced not by a problem of scarcity but of surplus, relative to effective demand. A crucial problem therefore is to secure markets for their surplus agricultural products. This is a study of the grain trade and grain traders. It identifies who they are and how they operate. It reviews U.S. farm policies since the Second World War, along with policies for trade and aid. It reviews the history of, and prospects for, multilateral trade agreements; and concludes with extensive criticisms of the current policies and actions and proposes a profoundly different approach.

Griffin, K., The Political Economy of Agrarian Change: An Essay on the Green Revolution, Macmillan, London, 1974

III A study of the economic, social and political consequences of the introduction of high yielding, or rather high response, varieties of rice and wheat in Asia and Latin America. The author argues that the introduction of new seeds and the accompanying technology have not increased agricultural production per head, nor reduced malnutrition. It has, however, accelerated the development of market-orientated agriculture, and the decline of subsistence farming. It has also accelerated the growth of wage labour and increased concentration of land ownership and the power of land owners.

Hartmann, B. & Boyce J., Needless Hunger. Voices from a Bangladesh Village, Institute for Food and Development Policy, San Francisco, 1979

II Drawn from their direct experience of work in the villages of Bangladesh, the authors provide a description of the social processes by which a minority of the communities have gained effective control over agricultural production. They argue that as a consequence these resources are underused and misused. They also locate these problems in a global context making connections with the food systems of numerous Industrialised Countries.

Hayami, Y. & Rutton, V.W., Agricultural Development: An International Perspective, John Hopkins Press, 1971

IV An investigation into the processes by which public sector agricultural research institutions respond to economic and social forces. The authors develop a formal, but partial, model of the ways in which technical and institutional changes are brought about by economic forces which reflect product demand, original resource endowments, and resource accumulation as it reflects the historical processes of economic development. This model deals essentially with production and productivity rather than demand or consumption.

Institute for Food and Development Policy, Food First: Resource Guide - Documentation on the Roots of World Hunger and Rural Poverty, IFDP, 1979

II A brief, but thoroughly annotated bibliography organised into four sections. They suggest in turn that

(1) The Cause of Hunger is Not Scarcity, Nor Overpopulation;
(2) The Cause of Hunger is the Inequality in Control Over Food Producing Resources;
(3) The Solution is Not Technology, Nor Agribusiness, Nor Official Foreign Assistance; and
(4) The Solution Lies in the Transformation Of Control Over the Resources That Produce Food.

International Labour Organization, Meeting Basic Needs: Strategies for Eradicating Mass Poverty and Unemployment: Conclusions of the World Employment Conference, Geneva, ILO, 1977

III A report of the tripartite World Conference on Employment, Income Distribution and Social Progress, and the International Division of Labour, Geneva 1976. The agenda had five main items:

(1) National employment strategies and policies for Developing Countries
(2) International manpower movements and employment
(3) Technologies for productive employment creation in Developing Countries
(4) The role of multinational enterprises in employment creation in the Developing Countries; and
(5) Active-manpower policies and adjustment assistance in Developing Countries.

The conference concluded by endorsing a 'basic-needs approach' to development and they generated a set of urgent recommendations addressed to the ILO and other UN agencies concerning a review of international manpower movement, and the need for technologies for the creation of productive employment. The report was also published with two volumes of background papers; Vol. I on Basic Needs and National Employment & Strategies, and Vol. II on International Strategies for Employment.

Jackson, T. & Eade, D., Against The Grain, Oxfam, 1982

III A systematic and polemical critique of programmes of food aid and their impact on hunger in Developing Countries. The argument is that food aid is frequently ineffective and often damaging as a form of aid. It undermines independence and self-reliance. Often it does not reach those who need it most, and can in practice do more harm than good. The authors do not recommend abandoning efforts to alleviate hunger, on the contrary they are seeking ways which will be genuinely effective.

Jacobson, M.F., Eater's Digest: The Consumer's Factbook on Food Additives, Anchor-Doubleday, 1976

II An informed and authoritative review of the safety and hazards of chemical food additives. This is not the work of an eccentric food fadist nor an uncritical defence of industrial practices. It provides a general overview of the use of food additives and an alphabetically ordered discussion of approximately 100 of the most commonly used additives. It also deals with 14 categories of food products listing their probable ingredients.

Katz, D. & Goodwin, M.T., Food: Where Nutrition, Politics and Culture Meet: An Activities Guide to Teachers, Centre for Science in the Public Interest, 1755 S Street N.W., Washington D.C. 20009, USA

II A uniquely useful document, intended for use by school and college teachers. It is full of imaginative suggestions for what teachers, pupils and students could do. It was produced for use in the United States, and deals with the US food system quite comprehensively before concluding with a discussion of hunger in Developing Countries. Although the descriptions of the activities are primarily appropriate to the U.S., they could readily be adapted to local circumstances for use in Developing Countries.

King, M. (et. al.), Nutrition in Developing Countries, £2.20 from TALC (Teaching Aids At Low Cost), Institute of Child Health, 30 Guildford Street, London WCIN 1EH, England. Spanish edition also available from Editorial Pax Mexico, Libreria Carlos Cesarman, S.A., Argentina 9, Mexico City, Mexico

II This is written in easy English and is intended as a book on what and how to teach nutrition in the Third World. The appendix explains how to use the book in class, and it covers a broad range of important topics. It was originally written for Central and West African use, but it contains much which is of value worldwide.

Lappe, F.M. & Collins, J., Food First: Beyond the Myth of Scarcity, Houghton Mifflin Company, Boston, 1977, for the Institute for Food and Development Policy; a revised edition in paperback, Ballantine, New York, 1978

II This book is written in a highly accessible question-and-answer format. It provides evidence for the claim that mass hunger in Developing Countries is not a consequence of an absolute scarcity. It explains that human beings are not so much a liability as a productive resource. It discusses the significance of the colonial heritage for the production and distribution of food, and particularly the impact of technological changes such as the Green Revolution. There is also a discussion of food trade and aid, and the role of multinational companies. The discussion concludes with some proposals intended to solve the problem of mass hunger by instituting arrangements for food self-reliance.

Leach, G., Energy and Food Production, International Institute for Environment and Development, 1975; IPC Science & Technology Press, 1976

III This is a study of the interconnections between problems of food and energy. The industrial food systems of the OECD countries now require approximately 0.8 tonnes of oil equivalent per person per year which is some three times the average per capita fuel use for all purposes in the Developing Countries. The author carefully documents the details of this use of energy in agriculture, food processing and distribution. He also argues that this process cannot be sustained by the Industrialised Countries, and is wholly unsuitable as a model for the developing world to follow.

Lipton, M., 'Urban Bias and Food Policy in Poor Countries', Development Digest, Vol.XVIII, No.4, 1980, National Planning Association, 1606 New Hampshire Ave., Washington D.C. 20009, U.S.A., pp.22-31

III Policies affecting food supplies tend to reflect urban influence and interests rather than rural interests in most Developing Countries. As a simple example, planning that encourages farmers to devote more resources to rich people's food leaves fewer resources for poor people's food. According to aggregate FAO data, the poorer half of people in Developing Countries probably get no more food than in the 1930's, although their country's real income per head is some 40%-80% higher.

Lofchie, M., 'Political and Economic Origins of African Hunger', Journal of Modern African Studies, Vol. 13, No.4, 1975, Cambridge University Press, pp.551-567

II Drought and famine have become inextricably linked in popular and academic analysis of African hunger. But if drought is the explanation, why has it not affected export crops as well as food crops? And why is hunger almost as acute in countries with no rainfall problem? The author argues that Africa's problems of food production have to do fundamentally with the dualistic structure of Africa's agricultural economies.

McDowell, J., 'Development of high protein/high calorie biscuits in Uganda using indigenous protein sources', East African Journal of Rural Development, Vol. 6, No.1 & 2, 1973, Dept. Rural Economy, Makerere University, P.O.Box 7062, Kampala, Uganda, pp.97-110

II Very few Developing Countries can afford to import high-protein foods in any quantity. It is therefore important that efforts be directed towards the use and development of indigenous food sources. This article describes the identification and development of a high-protein, nutritionally balanced food in Southern Uganda using locally grown foodstuffs. The nutritional composition, product appropriateness in terms of cost, storage, palatability and acceptability and the final biscuit recipe are discussed.

Manning, D., Society and Food: The Third World, Butterworths, 1977

II A teaching text for schools and colleges produced under the auspices of SISCON, the British organization concerning Science in its Social Context. This text seeks to introduce and connect six relevant dimensions of global food problems, namely: economics, politics, technology, nutrition, sociology and ecology. It contains excerpts from relevant readings in appendices, and a useful annotated bibliography of 28 items.

Mars, Z. (Ed.), The Green Revolution and Rural Technology, Institute fo Development Studies, University of Sussex, Research Digest, No.2, Autumn 1978

II An editor's introduction plus twelve articles which succeed in moving the debate on the Green Revolution beyond superficial slogans to serious analysis. Here the Green Revolution is not seen as a fixed package, but rather as a research programme which could develop in a variety of different directions. The authors discuss what they take to be the preferred directions by reference to a wide range of social, economic and technical considerations.

Maxwell, S., & Singer, H., 'Food Aid to Developong Countries. A Survey', World Development, Vol. 7, 1979, pp.225-247

III This paper reviews the evidence on the impact of food aid on economic and agricultural growth in Developing Countries. It identifies four elements of the case for food aid, and four elements of the case against it, and then critically reviews the empirical evidence in support of the eight contending arguments. The authors recognise that food aid has not always benefitted the intended recipients, but they seek to show how it might. While recognising that the use of food aid is influenced by a complex set of interests in recipient and donor countries, it identifies a set of guiding principles for maximizing the effectiveness of food aid.

Morehouse, W. (ed.), 'Population, Natural Resources and Human Welfare', in Morehouse, W. (ed.), Science and the Human Condition in India and Pakistan, Rockerfeller University Press, NY, USA, Section 4, pp.141-208

II Nine conference papers which look at the role of science in alleviating the human condition in Asia, paying particular attention to agriculture, fisheries, health and family planning.

Morgan, D., Merchants of Grain, Penguin Books, London & New York, 1980

II A dense but fascinating insight into the rather secret world of the international grain traders. The author was working as a journalist for The Washington Post in 1972 when he started to investigate sales of U.S. grain to the Soviet Union. He persisted with his inquiries and reveals an extraordinary account of sub-terranian power. Trade in food commodities links together many Developing and Industrialised Countries, and it can have substantial effects which might often be ignored or unperceived. This book is intended to enable us to scrutinise this usually closed world.

Nulty, L., The Green Revolution in West Pakistan: Implications of Technological Change, Praeger Publishers, New York & London, 1972

III The application of green revolution technology in West Pakistan in the 1960's raised gross agricultural output substantially. The authoress argues that the West Pakistan experience shows that very high economic surpluses can be earned by agriculture without huge levels of capital investment when new technologies are applied. She argues therefore against the view that agricultural investment is a serious drag on development. She also argues that the new technology could only be properly applied by those with access to fertilizer supplies and adequate irrigation, and so tends to intensify rural inequalities.

Palmer, I., Science and Agricultural Production, United Nations Research Institute for Social Development, Geneva, 1973

IV The fourth of an excellent series on the Green Revolution. An ecological, economic and social study of the new dwarf varieties of grain which were highly responsive to fertilizers. The text requires a mastery of complex biological and economic concepts, but rewards careful study.

Pearse, A., Seeds of Plenty, Seeds of Want: Social and Economic Implications of the Green Revolution, Clarendon Press, 1980

III A report of a set of detailed comparative studies on the introduction of high yielding varieties of grains into several Developing Countries in Africa, Latin America and Asia. The green revolution is not analysed simply as a set of new technologies, but as one element in complex social systems. In this way the author is able to detail the processes by which food production can be increased while at the same time contributing to the impoverishment and malnutrition of the displaced peasantry.

Poleman, T.T., 'World Food - A Perspective', Science, Vol. 188, 9 May 1975, American Association for the Advancement of Science, pp.510-518; reprintedt in Food: Politics, Economics Nutrition and Research, Abelson, P.H. (Ed.), American Association for the Advancement of Science, 1975, pp.8-16

II A clear statement of the Malthusian view of the relationships between food, population and hunger, and an equally clear critique of that set of claims. The author examines, in particular, the prevalence of Malthusian thought within the United Nations Food and Agriculture Organisation from 1945 to 1975. He examines the role of United States of American agriculture in providing grain and other foods for the world markets, and then provides a prognosis for population control, food consumption, food production and employment in Developing Countries.

Rao, S.R., 'An Example to the Third World', New Scientist, Vol. 59, 23 Aug. 1973, Commonweatlth House, 1-19 Oxford Street, London WCIA ING, pp.451-452

II In response to criticism of the impact of foreign aid on economic growth in Developing Countries, this describes an attempt to implement a policy of self-reliance in the context of an Indian dairy products co-operative. This is a report of a particularly successful project in utilizing appropriate scientific knowledge and technology in socially productive ways.

Robbins, C. & Ansari, J., The Profits of Doom, War on Want, London, 1976

II A brief, but powerful, pamphlet on the crisis of hunger and malnutrition in Developing Countries. It is a response in particular to the discussion at, and proposals from, the 1974 Conference in Rome of the United Nations Food and Agriculture Organisation. It offers an outline diagnosis of the social and economic causes of hunger and discusses the kinds of changes in national and international policies and actions which would be needed to relieve the crisis. This booklet would be suitable for use with pupils age about 13+.

Sen, A., Poverty and Famines: An Essay on Entitlement and Deprivation, Clarendon Press, Oxford, 1982

II This book examines the general causes of starvation, but pays particular attention to acute famines. The author argues persuasively that traditional explanations in terms of scarce food supplies are profoundly mistaken, despite their superficial plausibility. He develops an alternative form of analysis in terms of the concept of 'entitlement' which enables him to show that problems of demand (i.e. poverty) are crucial factors. By reference to a set of case studies including the Bengal Famine of 1943, the Ethiopian famines of 1973 and 1974, and the Bangladesh famine of 1974, the author shows that in each case the problem was not that of aggregate scarcity but of acute poverty.

Singer, H.W., Technologies for Basic Needs, ILO, Geneva, 1977

III Essentially concerned with appropriate technologies for the satisfaction of basic needs in rural communities in Undeveloped Countries. It considers relations of Undeveloped Countries to Developing Countries and technology transfer from the points of view of the recipients. Deals specifically with problems of education, training and skills; and with institutional and organizational factors.

Sinha, R., Food and Poverty: The Political Economy of Confrontation, Croom Helm, London, 1976

II This book argues that hunger is largely a consequence of poverty and unemployment. It aims to show that at both national and international levels, there is a reluctance to take a realistic view of the steps which are necessary to eliminate poverty, unemployment and malnutrition. It argues that the mechanisms of a market economy alone cannot overcome the problems of poverty, and that current interventions into the market place are either marginal palliatives of misplaced efforts. It argues that ultimately any major eradication of poverty will not be possible without a comprehensive revision of the current patterns and policies of trade and investment.

Sinha, R., The World Food Problem: Concerns and Conflict, Pergamon Press, Oxford & New York, 1978

III This is a reprint of World Development, Vol. 5, Nos. 5-7, pp.371-664. It contains 27 articles including an editor's introduction, plus a selected but unannotated bibliography. The editor explains that a concensus has been reached, at least amongst the experts represented here, that alarming prognostications about the inevitability of mass starvation and 'triage' are a flagrant denial of the social and technological possibilities for both increasing agricultural production and reducing family size. Most now accept that hunger and malnutrition are problems of distribution rather than of production. There are also conflicts of interpretation and of interests and these papers highlight both consensus and the conflict.

Tannous, A. I., 'Organizing Science and Technology for Agricultural Development', in Nader, C. & Zahlen, A.B., Science and Technology in Developing Countries, Cambridge University Press, 1969, pp.61-84

II A discussion of the social conditions under which scientific and technological progress in agriculture can be made appropriate to the needs and problems of the rural populations with particular emphasis on the role of literacy and education in the modernization of agriculture, and the importance of patterns of land tenure.

Tudge, C., The Famine Business, Faber & Faber, London, 1977

II Mass hunger, according to this author, is not inevitable, but a direct consequence of the policies of numerous governments and companies. He argues for a rational agriculture which could readily feed the existing world's population and cope with likely future growth. He criticises current food policies which are based on industrialised monocultural agriculture, on patterns of trade which are inequitable and wasteful, and on processing to add commercial rather than nutritional value to food products. In their place, he argues for the maintainance and reinforcement of traditional agricultural methods and eating habits, for only in these ways can the entire human population be satisfactorily fed.

Verrett, J., & Carper, J., Eating May Be Hazardous To Your Health, Anchor-Doubleday, New York, 1975

II One of the authors of this book worked as a research scientist for The United States Food and Drug Administration. The text details some of the problems concerning the presence of chemical residues, contaminants, and additives in modern food products. The first four chapters discuss the institutional organisation and operation of the U.S. regulatory system, but the next five chapters examine the possible toxicity of five groups of chemicals which are to be found in food products.

VITA, How to Perform an Agricultural Experiment, Volunteers in Technical Assistance, 3706 Rhode Island Avenue, Mount Rainier, Maryland 20822, USA (in English & Spanish) US $1.50, 23 pages

II A straightforward account for local agriculturalists, schools and colleges on the basic factors in the design and conduct of agricultural experiments.

Barnet, H.J., 'Population Problems - Myths and Realities', Economic Development and Cultural Change, Vol. 19, July 1971, University of Chicago Press, pp.545-59

III Rebuttal of the famous "law of diminishing returns" which formed the basis of Malthusian economics and which still forms the arguments for population control. Shows that technological progress changes the very resource base of society, expanding the physical limits of resource availability.

Bekele, M., 'False Prophets of Doom', UNESCO Courier, July-Aug 1974, UNESCO, Paris, pp.42-45

II Written by the head of the Social Services Department of Ethopia, the article exposes the dangers of "playing the numbers game" and accepting Western doomsday preachers in the field of population. Shows historically how Europe underdeveloped Africa and concludes that only through massive development efforts and mobilisation of people might Africa stabilise its population.

Borgstrom, G., Too Many: A Study of Earth's Biological Limitations, Macmillan, New York & Collier-Macmillan, London, 1969

II A classic statement of the thesis that the globe cannot continue to sustain an ever-growing human population. It deals not just with food but with other material resource requirements particularly water. The author gives special attention to the scope and limits of the contribution which scientific and technological developments might play in alleviating what is seen as an actual or potential crisis.

Cipolla, C.M., The Economic History of World Population, Harvester Press (hardback) and Penguin Books (paperback), 1978

II This text is an attempt to approach the history of population and wealth from a global point of view rather than as the sum of national economic histories. The historical span of this work is from the time of the earliest human agricultural settlements right up to the present day. The author contends that each of the three basic types of human economic organizations: hunting, agricultural and industrial, are accompanied by three corresponding ranges of economic activity and demographic levels.

Cole, H.S.D., et.al.(eds.), Thinking About The Future: A Critique of the Limits to Growth, Chatto & Windus, 1973

II A systematic critique by members of the Science Policy Research Unit of the University of Sussex of the Club of Rome's report (Meadow et.al. q.v.). The authors reveal and criticise the Malthusian assumptions of the Club of Rome's model; see especially Ch.1 'Malthus With A Computer', Ch.4 'The Population Sub-System', and Ch.10 'Malthus and Other Economists'.

Commoner, B., 'How Poverty Breeds Over-population', Ramparts, No.31, 1975; reprinted in Population and Human Resources and in Arditti, R. et.al. (eds.), Science and Liberation, South End Press, Boston, Massachusetts, 1980

II A concise and incisive statement of the view that the world does not confront a Malthusian crisis of overpopulation, but that mass hunger is a social artefact which can be eliminated by social rather than by purely technological means. The paper also serves as an illustration of the theory that a mistaken belief that science alone can solve social ills can aggravate rather than assist with the solution of social problems. This might be because the mistake may lead scientists to attempt solutions from a narrow technological perspective and to ignore the social and political realities of the problems, and thereby contributing to the development of social relations which might be more antogonistic.

Djerassi, C., The Politics of Contraception, W.W. Norton, New York & London, 1979

II Inevitably the complex "hardware" of modern contraceptive methods impinge upon the cultural, political and religious values of a society. After a detailed look at the various hardware, concentrating on the development of the contraceptive pill, the book discusses the questions of why, when and whether to use birth control, the obstacles to its success and possible future developments in technology. The case of China is used to illustrate.

East-West Centre and East-West Communication Institute, Sources of Information on Population/Family Planning: A Handbook for Asia, E.W. Centre, Honolulu, Hawaii, USA, 1975

III Contains profiles of 64 national, regional, and international organizations which provide information and materials on various aspects of population and family planning in Asia. There are details on library services, publications and informational activities.

Franke, R.W., 'Labour, Land and People', Populi, Vol.8, No.4, U.N. Fund for Population Activities, 220 East 42nd St., New York 10017, pp.8-31

III For three decades foreign aid, development programmes and research into underdevelopment have been dominated by the view that "overpopulation" is a major cause of poverty: whatever your cause, it is a lost cause without birth control. However, the West African data presented here offers substantial evidence that demographic factors may be the result of systems of production that have had the effect of continuously pulling labour power out of local economies, thus imposing severe labour shortages. These shortages were made up by high birth rates, migration or, in some cases, no population response, leading to massive break-down of the production system.

Grigg, D., Population Growth and Agrarian Change: A Historical Perspective, Cambridge University Press, 1980

II Since the Second World War a great deal of attention has been paid to the consequences of rapid population growth for rural societies in Developing Countries. European societies faced similar problems in their past, yet appear to have coped with their problems of population growth without catastrophy. This book examines the relations between population growth and agrarian changes in relation initially to Europe at various times over the past five hundred years. Comparisons are then drawn with the potential problems of Developing Countries today.

Guest, I., 'The Great Pill Push', New Internationalist, No.49, 1977, 62a High Street, Wallingford, Oxford, pp.12-14

II Preoccupation with population control to the neglect of health care in Bangladesh has lead to chaotic programmes in each. Young children are needed to contribute to the welfare of the family, so families will take willingly to contraceptives only if they are assured that health care will be provided for their surviving children. As it is infant mortality remains high. An effective distribution service and follow-up treatment must be guaranteed before a programme of population control begins.

Hamelstein, H. & Segal, B., 'Women and the Population Issue', World Citizen/Federalist Newsletter, Vol.XX, No.6 July-Aug. 1974

II Concise expose of the hypocrisy of the male-dominated population control establishment which now seeks to present efforts to reduce population growth through family planning as a means to women's liberation. It professes to support women's liberation because it will contribute to this goal. In fact existing programmes treat women as "targets" whose fertility is to be reduced while refusing them any real options in life.

Hofstein, E., 'The Family Planning Controversy', Monthly Review, Vol.26, 1974, Monthly Review Press,pp.17-30

II Straightforward, well-argued and comprehensive critique of the neo-Malthusian position. Concludes that without meaningful economic development in the Third World there will be no rapid decline in fertility and that unless imperialism is neutralised and eliminated no proper development will take place. Family planning on its own is not the answer.

Johnson, S., The Population Problem, David & Charles, Newton Abbot, Devon, England, 1973

III A connected set of excerpts from international agencies and spokesmen, organised with a discussion and commentary which seeks to describe the crisis of over-population in Developing Countries and possible responses to it. The text is organised into five parts. The first presents an account of some facts and figures and an interpretation of their meaning. Part 2 examines the Developing World, while part 3 considers the Developed World. Part 4 reviews problems which are seen as obstacles to action, including the Roman Catholic Church, the teachings of Islam and the attitudes of women. The final section deals with the policies and actions of major international organizations.

Kuznets, S., Population, Capital and Growth: Selected Essays, Heinemann Educational Books, 1974

III This collection of essays explores the thesis that in most Developing Countries purely technological and economic factors permit substantial and sustained economic growth, even with a significant rise in population. The problems lie in the limited capacity of the institutions in these countries - political, legal, cultural and economic - to channel activity so as to exploit the comparative advantages of a developing economy in the international market-place. But these problems may be exacerbated when a rise in overall population means a greater disparity between lower and upper income groups. Technological changes requiring more education and investment in human capital may impede upward economic and social mobility indispensible to the efficiency of the economic society.

Mamdani, M., The Myth of Population Control: Family, Caste and Class in an Indian Village, Monthly Review Press, 1972

II Analyses the failure of a six year, million-dollar field study organised by the Indian government, Harvard University and the Rockerfeller Foundation examined the effect of an intensive birth control programme in Punjab, India. Mamdani argues that the programme failed because of grossly incorrect assumptions by the organizers as to the nature of Indian village life and structure. Shows how the economic realities of village life made birth control extremely unattractive, poverty and powerlessness leave no option but for large families, and only improvement in the social well-being of the villager will radically affect fertility.

Mass, B., 'An Historical Sketch of the American Population Control Movement', International Journal of Health Services, Vol.4, No.4, 1974, Baywood Publishing Company, pp.651-676

II In 1973 this journal devoted an entire issue to the population question ("Population Growth in International Perspective", Vol.3, No.4). This article is a response to the ensuing debate. (See also Park, R.M. below.) It links together the eugenics and population control movements by showing the similarities of origins, aims and support from the U.S. ruling class. It traces the growth of the eugenics movement in the 19th and early 20th centuries and shows how the decline in respectability of eugenics in the 1930's prompted many leading eugenicists and eugenics organisations to shift their emphasis to population control, and how they subsequently built up the powerful population establishment which exists today.

Mass, B., Population Target - The Political Economy of Population Control in Latin America, Latin American Working Group, Toronto, 1976

II A political critique of Malthusian theories of population, and of programmes of population control introduced into Latin America from the United States and by international agencies. The authoress sees the theories as profoundly ideological and oppressive, and the birth control programmes as incompatible with the real needs and interests of the target groups. She argues that poor women in Latin America need to gain control of their economic and reproductive lives and should not have their real interest subordinated to an alien technological intervention.

Meadows, D. H. & Meadows, D.L., The Limits to Growth, Pan Books, 1974

II A stark contemporary statement of the classic Malthusian position, threatening a population explosion catastrophe as one of several possible catastrophies.

Michaelson, K.L. (ed.), And The Poor Get Children: Radical Perspectives on Population Dynamics, Monthly Review Press, 1981

II An editorial introduction and nine papers which collectively argue not that the world is confronted by a biological problem of overpopulation, but rather that industrial and commercial developments encourage population growth while at the same time developing technolgies which make people superfluous. The surplus population then drives down wage rates and forces family size to grow to increase the numbers of labourers per household. Hence they argue that high birth rates are not the cause of poverty, but rather a consequence of poverty.

Organisation for Economic Co-operation and Development, An Introduction to Information Resources in the Population Field, OECD, Paris, 1973

III A fifteen page booklet which lists and evaluates bibliographies, source books, directories, periodicals, and other basic information materials on population.

Overbeek, J., History of Population Theories, Rotterdam University Press, 1974

II Essentially an economic history of theories of human population. The primary focus is from the mid-eighteenth century to the 1970's, and the author presents the history as a connected set of controversies between those who fear population congestion and those who don't. The author does not merely describe the theories, but also attempts to take a critical perspective. He concludes with the hope and belief that the confirmed growth and refinement of analytical tools in economics and demography will make possible an increasing area of consensus on aspects of the population issue.

Park, R.M., 'Not Better Lives, Just Fewer People: The Ideology of Birth Control', International Journal of Health Services, Vol.4, No.4, 1974, Baywood Publishing Company, pp.691-700

II One of the best analyses of the ideology of population control and its function within the existing world order. It argues that in attacking the symptoms instead of the problem - rapid population growth instead of a social order allowing no hope for a better future - population control is not only futile but reactionary.

Parsons, J., Population Fallacies, Elek Books Ltd., 54-58 Caledonian Road, London N.1, for Pemberton Publishing Co., 1977

II The author catalogues fourteen fallacies concerning world demography. Five are identified as common sense fallacies, two are scientific in character; and seven are economic. Each of these "fallacies" has been presented as arguments for ever increasing population growth and/or economic growth. The author argues that the underlying fallacy is located in short-term thinking which fails to take either a long term perspective or adequate account of the finiteness of the earth.

Pohlman, E., (ed.), Population: A Clash of Prophets, Mentor Books, New York, 1973

II A collection of 85 contributions to some of the many sides of a complex debate. Some have argued that birth rates are too low while many have argued that they are massively too high. This collection attempts to bring together many, if not all, sides of the debate. The idea of the volume is to expose the readers to a very wide range of opinions and to confront them with the need to make up their own minds.

Poleman, T.T. & Freebairn, D.K. (eds.), Food, Population and Employment: The Impact of the Green Revolution, Praeger, 1973

III Two hundred years ago in the West enclosure and the "new agriculture" ushered in the Industrial Revolution and its attendant problems of poverty, exploitation and unemployment. Similarly for the Developing Countries the Green Revolution has been far from an all-solving panacea. The proceedings of this workshop trace some of its more clear-cut social, political and economic consequences.

Pradervant, P., 'The Best Pill is Development', CERES: FAO Review on Development, Special Population Issue, Nov.-Dec. 1973, FAO, via Delle Terme di Caracalla, 0100, Roma, Italy, pp.6-9

II "The pill is not the means of avoiding the upheavals, reforms and revolutions which are inevitable in the Third World. Intelligently applied, for humanitarian purposes, it could do something towards lessening suffering; clumsily manipulated for political ends it could perhaps postpone the moment of truth." In this collection of brief articles by demographic specialists, the author summarises the arguments for the view that without an economic breakthrough it is unthinkable that birth control will take hold in poorer countries.

Schools Council General Studies Project: Population and Environment Teaching Unit, M. Wild (ed.), 1975, Longman Resources Unit, 35 Tanner Row, York, England

II A pupil orientated course unit with reprints of useful materials, suggestions for pupil activities, and references to The Scientific American dealing with global issues of human populations in relation to nature and pollution.

Segal, A., 'The Rich, the Poor and Population', in Demography India, Vol. II, No.1, June 1973, A/3 Institute of Economic Growth Campus, University Enclave, Delhi-7, India, pp.5-17

II Rich people are often explicit in holding fertility responsible for poverty. As a result, aid to Developing Countries is limited for all measures but population control. On the other hand, the poor countries, and the poor within rich countries, are more inclined to explain their poverty as a consequence of the policies and practices of the rich. The roots of this problem and its consequences are discussed.

Social Science and Medicine, Vol.14C, No.2, 'Health and Population in Developing Countries', Pergamon (Journals Division), Headington Hill Hall, Oxford, OX3 0BW, U.K.

III Part C of Social Science and Medicine deals with Medical Economics, and this edition is a report from a conference held at Bellagio sponsored by the Rockerfeller Foundation (with co-operation of the Ford Foundation and the IDRC). The papers emphasise a need for continued serious attention to population programmes but express concern about the safety of currently used contraceptives, and call for further research. There are also reports on changing patterns of health and mortality in Developing Countries. Many of the papers propose policies as well as recording data and providing analyses.

Symonds, R. & Carder, M., The United Nations and the Population Question 1945-1970, Chatto & Windus for Sussex University Press, 1973

III This is a historical account of the discussions and actions of the United Nations Organization and the League of Nations which preceded it. It examines in particular the specialised agencies which have been active in this field, particularly the World Health Organization, the U.N. Food and Agriculture Organization, the International Labour Organisation and UNESCO. The book attempts to trace the ways in which the policies of the agencies of the U.N. have evolved, in response to what forces, and what influence the U.N. has had on national governments and agencies.

Trzyna, T.C., Population: An International Directory of Organizations and Information Resources, Public Affairs Clearing House, P.O. Box 30, Claremont, California, 91711, USA, 1976

III The purpose of this volume is to provide a central source of information about organizations concerned with population and family planning, their programmes and activities, key personnel publications and other information resources. Emphasis is on international organizations, and those based in North America. Only the final section gives some listings for organizations in Developing Countries.

Dakhil, F. H., Urkal, O. & Tewfik, M.F. (eds.), Housing Problems in Developing Countries, Vols. 1 & 2, University of Petroleum and Minerals, Dhahran, Saudi Arabia, & J. Wiley & Sons, 1978: The Proceedings of the International Association for Housing Science International Conference in 1978

IV Twenty seven papers organised into two volumes and divided into fifteen sections dealing with: Building Science, Housing Projects, Energy, Environmental Studies, Economics and Management, Innovative Design and Construction, Low Income Housing, New Materials and Construction, Performance Criteria, Sociological Factors, Specifications and Disaster, Systems Approach, Urban Development and Policy, Housing in Saudi Arabia, and a set of Miscellaneous Papers.

Desai, A.R., & Pillai, S.D. (Eds.), Slums and Urbanization, Popular Prakashan, Bombay, 1970

II A useful collection of articles on slums and barrios by leading authors. Organised into eight sections dealing with the general character of slums and how they can be comprehended. It then considers specifically slums in: the USA, Latin America, Asian cities, India, and urban renewal.

Golger, O.J., Squatters and Resettlement: Symptoms of an Urban Crisis: Environmental Conditions of Low-Standard Housing in Hong Kong, Otto Harassowitz, Wiesbaden, 1972

IV A report of empirical studies of three squatter settlements and three resettlement estates. The research is intended to identify the problems, possibilities and limitations on life in over-crowded low-standard squatter settlements or in multi-storey dwellings. The study also sought to explain how life at high density is possible in Hong Kong.

Hardog, J.E. & Satterthwaite, D., Shelter: Need and Response - Housing, Land and Settlement Policies in Seventeen Third World Nations, J. Wiley & Sons, 1981

III This book is the product of a study of five teams based in London, Khartoum, Mysore, Buenos Aires, Lagos, Nairobi and Tanzania. It summarises housing land and settlement policies in 17 Developing Countries and compares and contrasts their effectiveness in a search for effective commonly applicable policies. They find widely differing national responses to the problems; but despite a few promising signs they conclude that government action is virtually always inadequate and often ill-directed. The authors hesitantly offer three mains sets of recommendations dealing with efforts to reduce or eradicate poverty, and with the spatial implications of natural development plans, and with the optimum use of limited financial resources.

Jacobs, J., The Economy of Cities, Jonathan Cape, 1970

II This book is intended to provide an answer to the question as to why some cities decline and die while others live and grow? In general, most commentators have assumed that economies depend for their growth on large, industrial institutions, and today the huge modern corporation is taken to be the essential engine of development. The authoress argues here precisely the opposite case. She maintains that the health of city life depends not on the further expansion of the already vast institutions but on the more unpredictable growth of innumerable offshoots from old corporations, and the new enterprises may even replace the old, and in any case supplement them. If her thesis can be sustained it has profound implications for policies regarding economic development, scientific and technological research and the planning of cities and housing developments.

Langley, P., What Architecture for Rural Housing? An Analysis of the Production of the Built Environment, Occasional Paper No.77-17, Environment Training Programme, P.O. Box 3370, Dakar, Senegal, 1977, pp.66

III National rural housing policies have often not had the expected results. The author suggests that an analysis of the social conditions which give rise to architecture is necessary before such policies can be drawn up. He describes a new orientation for architecture within a strategy of self-reliant development, demonstrating that the process of design production, appropriation and use are just as important, if not more so, as the physical aspect of the building. Choice of building technology and materials is crucial.

Lewin, A.C., Housing Co-operatives in Developing Countries: a Manual for Self-Help in Low-Cost Housing Schemes, John Wiley and Sons, 1981

III The problems of urban housing differ substantially from those of rural housing. Past proposals for the promotion of urban housing co-operatives in the Developing Countries in general have often demanded that government should take positive action, provide grants and adjust legislation. This practical manual on the other hand assumes that adequate programmes and policies can only follow from an accumulation of experience. Rather than present quantified solutions, its aims are to encourage discussion on the various issues related to the promotion of urban housing co-operatives, the ultimate solutions to which must be adapted to social, economic, cultural and political conditions.

Mabongunje, A.L., Hardog, J.E. & Misra, R.P., Shelter Provision in Developing Countries: The Influence of Standards and Criteria, published on behalf of the Scientific Committee on Problems of the Environment (SCOPE) and the International Council of Scientific Unions (ICSU) by J. Wiley & Sons, 1978

III A survey of the provision of shelter and associated environmental conditions in which the authors argue for the importance of environmental quality for human happiness, and that bad housing and inadequate services results in yet further environmental damage. The authors also argue that the need is less for technical solutions than for the means to implement such solutions. This study results from co-operation between reseach groups in Latin America, Africa and South Asia.

Mitchell, R.E., Housing, Urban Growth and Economic Development, Asian Folklore and Social Life Monographs, Vol. XXXI, the Oriental Cultural Service, Taipei, 1972

II A discussion of the significance of housing in urban growth and economic development, ranging from the macroscopic aspects of land-use planning to microscopic aspects of peoples' use of, and responses to, their homes. The author strives to combine the macro and micro perspectives to generate policy guidelines for urban land-use and housing developments, especially for cities with large and expanding populations on low incomes.

MARGA Research Studies - 6, Housing in Sri Lanka, Marga Institute, Colombo, 1976

II An examination of twenty years of housing development in Sri Lanka, and an attempt to forecast future needs. It tries to formulate an overall strategy for housing policy in Sri Lanka which takes due account of both rural and urban needs and to locate the whole analysis within a development programme in pursuit of both growth and equality.

Morrison, M.K.C. & Gutkind, P.C.W. (eds.), Housing the Urban Poor in Africa, Maxwell School of Citizenship and Public Affairs, Syracuse University, New York, USA, 1982

II The collected papers of the Annual Africa Colloquium of April 1980: Eight papers, including an introduction and conclusion. The papers collectively emphasise the significance of the historical context, particularly colonial housing policies, from which contemporary problems have emerged. Moreover they also discuss some of the ways in which urban developments depend upon traditional rural patterns of life.

Murison, H. S. & Lea, J. P. (eds.), Housing in Third World Countries: Perspectives on Policy and Practice, Macmillan, London, 1979

III A collection of nineteen articles, plus an introduction and conclusion, organised into two sections on (I) Housing and Development and (II) Housing and Technology; based on an International Workshop on Housing for Third World Countries, in Australia in 1978. The participants emphasize that housing is not just a technical problem, but a socio-economic one; and that employment for poorly housed people is a crucial issue. There is particular consideration of labour intensive appropriate building technologies which fit the relevant social needs.

Oliver, P., (ed.), Shelter in Africa, Praeger, New York, 1971

II A discussion of the relations of built forms to their locations as regards both traditional settings and urban areas. Deals with problems of urbanisation and slums, and provides a detailed discussion of some examples of housing improvements. Well supported by illustrations, maps, photographs, designs and a bibliography.

Payne, G.K., Urban Housing in the Third World, Leonard Hill, London & Routledge, Boston, 1977

II An examination of policies and practices concerning the development of Third World cities, and particularly housing for low-income groups. The book is in four parts. Parts I and II study the historical, economic and social context of rapid urban growth, and in particular considers the limitations of the assumptions of much contemporary thought on these matters. Part III consists of a detailed case study of low-income settlement in Delhi, and Part IV draws the preceeding material together into policy prescriptions for future alternative approaches to the problems

Rapoport, A., House Form and Culture, Prentice-Hall Inc., Englewood Cliffs, N.J., USA, 1969

II This book is an attempt to present a cross-disciplinary analysis of house form. It introduces a conceptual framework for analysing the nature of house design and the forces which influence it; social and cultural, climatic, material and technological. In its presentation it draws on a very wide range of examples.

Ravetz, A., Remaking Cities, Croom Helm, London, 1980, £7.95

III An analysis and critique of the impact of planners, architects and developers upon British cities. It explores in particular the contradictions between the early ideals and expectations of planners and the eventual consquences of their actions. The book critically examines both the ideas and the constructions which have transformed British cities since the second World War. Although the discussion is based on the British experience, the arguments have very wide application throughout the industrialised and developing worlds. Ravetz argues that only a radically new approach will enable us to us to avoid past mistakes and to construct a bettwe urban environment.

Sarin, M., Urban Planning in the Third World: The Chandigarh Experience, Mansell, London, 1982

I: This work addresses some critical issues of urban planning in the Third World. Chandigarh was designed by Le Corbusier as the new capital of the Punjab, and the architect finalised his master plan in a matter of days. That plan, and its implementation, not merely ignored but actively excluded a major sector of the population from legal housing and employment. The book traces the problematic evolution of the scheme and the growth and impact of unplanned settlements. The author draws conclusions of abiding relevance to town planners and architects in the Third World.

Schlyter, A., Science and Technology Transferred by International Agencies in the Field of Housing: the Zambian Case, University of Lund, Research Policy Programme, Discussion papers No. 109, 1977, pp.16

III From a study of Zambia, this paper sets out to ask what kind of expertise have international organisations and the Industrialised Countries offered in the field of housing? And what impact have science and technology had on the housing situation for the mass of the people? It concludes that technology transfer has had no important impact on the housing situation of the working class. On the contrary, the international agencies such as the U.N. and the World Bank have played an important part in strengthening the relations of dependence and consolidating the growing administrative and bourgeoise classes in the Developing Countries.

Schoorl J.W. et.al., Between Basti Dwellers and Bureaucrats, Pergamon Press, Oxford, 1983

IV A review of twelve years of work by a team from the Amsterdam Free University of slum improvement in Karachi, Pakistan. The articles describe the city of Karachi and its squatter settlements, policies for these settlements, the implementation of those policies, and problems arising from their implementation.

Slate, F.O., et.al.(eds.), Low-Cost Housing for Developing Countries: An Annotated Bibliography 1950-1972, Program on Policy for Science and Technology in Developing Nations, Cornell University, June 1974

III An extensive bibliography well-organised and annotated. Divided into 26 sections ranging from planning, design and construction through self-help to health and environmental considerations. Includes country, regional and case studies.

Stren, R.E., Housing the Urban Poor in Africa, Institute of International Studies, University of California, Berkeley, 1978

IV A detailed study of the housing problems of Mombasa, Kenya in the mid 1970's. It attempts firstly to examine the imact of local and national regulatory and developmental housing policies on the local population. The author is particularly interested in the overall policy process, namely: goal formulative, policy determination and implementation, and policy impact. The author concludes (a) that there has been continuity in Kenyan housing policy from the colonial period through to the 1970's; (b) that developmental and regulatory policies have tended to go in opposite directions; (c) that local factional politics has had a strong influence on regulatory policy but practically no influence on developmental housing policy; and (d) that despite official pronouncements, low-income groups have been overwhelmed by the "managerial bourgeoise" in shaping developmental policies.

Trinker, I. & Buvinic, M., The Many Facets of Human Settlements: Science and Society, papers prepared for the U.N. Conference on Human Settlements, Pergamon, 1977, £48

II This assembly of articles comprehensively surveys the problems of housing which fact the countries of the world, Industrialised and Developing alike. Throughout this volume much hope is placed on devising efficient solutions through technological innovations. One article sfates that most promising technologies will come not from the Industrialised but from the Developing World, where the needs and incentives for the creation of small-scale technologies is greatest. However, action must be grounded on local needs and values, with understanding of the physical, socio-economic, cultural and psychological character of habitats and dwellers. Unfortunately this is an expensive book.

Ward, P.M. (Ed.), Self-Help Housing: a Critique, Mansell, London, 1983, £17.50

II This collection surveys the role which self-help housing has played, and might play, in the development of urban accommodation. It includes a debate on whether self-help housing is an effective bootstrap by which the poor can help themselves, or whether it merely depresses further their already low incomes. It also considers the conditions necessary for success in self-help housing schemes.

Yeh, S.H.K. & Laquian, A.A. (eds.), Housing Asia's Millions: Problems, Policies, and Prospects for Low-Cost Housing in Southeast Asia, International Development Research Centre (IDRC), Ottawa, 1979

IV Researchers from eight countries varying from Laos to Singapore and Hong Kong have reviewed land provision and policies, housing design, administration, finance, urban and regional planning, and problems of squatters and slum dwellers. The IDRC has published their work separately, but this volume seeks to sythesize their results in a comparative discussion to point out conditions for success and failure in housing policies.

Akhtar, S., Low-Cost Rural Health Care and Health Manpower Training, International Development Research Centre, Ottawa, Canada, 1975

III An annotated bibliography with 700 entries. Free to educational institutions in Developing Countries. IDRC will attempt to supply a copy of any publication listed in the bibliography, if it is not otherwise available.

Bryant, J.H., 'The Gap Between Biomedical Technology and Health Needs in Developing Countries' in Nader, C. & Zahlen A.B., Science and Technology in Developing Countries, Cambridge University Press, 1969, pp.1-30

II An argument that the technology developed in relation to the health care needs in the industrialized world "actually lacks the capability for providing the health care needed by most of the world people" (p.5). An explanation of this claim, and an analysis of the characteristics of desirable alternative health care socio-technological systems.

Chetley, A., The Baby Killer Scandal, War on Want, 1979

II A critical examination of the effects the promotion and sale of powdered milk for use with babies in Developing Countries. The author argues that breast feeding is, almost invariably, preferable to bottle feeding and that the reliance on bottle feeding contributes to malnutrition and the prevalence of infant infections. In particular there is a critical discussion of the role of the companies which manufacture and promote the use of these products.

Doyal, L. & Pennell, I., 'Health, Illness and Underdevelopment', in Doyal and Pennel, The Political Economy of Health, Pluto Press, 1979, Chap. 3, pp.96-137

II High mortality rates which characterise underdevelopment tend to be seen as the inevitable consequences of natural climatic and demographic conditions. However, population growth is simultaneously cited as evidence of improvement in Third World health, widely credited to Western medicine. This view exaggerates the role of scientific medicine in solving health problems and, more importantly, obscures the role of imperialism in the creation of ill health in Developing Countries. The prevalence of most diseases in these countries is in fact greater than a century ago.

Durbin, P.T., A Guide to the Culture of Science, Technology and Medicine, The Free Press, New York & Collier Macmillan, London, 1981

III This volume contains several chapters of specific relevance to health, namely chapters 3, 6, 7 and 8 which deal with the history, philosophy and sociology of medicine.

Hall, B.L., 'Revolution in Rural Education: Health Education in Tanzania', Community Development Journal, Vol. 9, No. 2, April 1974, pp.133-39

II An account of the intentions, design and implementation of two programmes of wide scale dispersed health education in Tanzania from 1969 to 1973. It refers to the radio programmes, printed materials and study groups. There is also a discussion of a wide-scale preventative health education programme. The author concludes his brief evaluation with the claim that these projects were both cheap and effective.

Horrobin, D.F., Medical Hubris: A Reply to Ivan Illich, Churchill Livingstone, 1978

II Practising doctors and medical scientists are often impatient with those interested in the philosophy of medicine. However, Illich's philosophy is currently very influential and the author is worried that acceptance of his ideas without analytical criticism could lead to a disaster in medicine in years to come. This book intends to point out the logical flaws in Illich's proposals for change which could precipitate such a crisis.

Hughes, R. & Brewin, R., The Tranquilizing of America: Pill Popping and the American Way of Life, Harcourt Brace Jovanovich, New York & London, 1979, and Warner Books, (paperback) 1979

II This is intended both to describe and explain the excess use of, and reliance upon, tranquilizing drugs in the USA, but also to provide American readers with practical advice on how to overcome their reliance. While people in Developing Countries will not be experiencing similar problems, it is illuminating to recognise some of the limitations of the health care systems and technologies of the industrialised world.

Illich, I., Limits to Medicine - Medical Nemesis: The Expropriation of Health, Pelican, London, 1977

II Many people are already apprehensive about doctors, hospitals and the drug industry. The lack of effectiveness of costly, high risk medicine is widely discussed. In fact: "The disabling impact of professional control over medicine has now reached the proportions of an epidemic." With this opening statement and basic contention, the author sets out a powerful social critique of contemporary medicine. A reply to this highly influential book is given in Horrobin, D.F.(q.v.)

Kunstadter, D., 'Medical ethics in cross-cultural perspective', Social Science and Medicine, Vol. 14B, 1980, pp.289-296

II The author reviews debates in medical ethics showing that their focus is primarily on the Industrialised Countries, but argues that there are different but more urgent and important questions for Developing Countries especially regarding the allocation of scarce medical resources.

Lemma, A., 'Schostosomiasis: the social challenge of controlling a man-made disease', Impact of Science on Society, Vol. 23, No. 2, 1973, Paris, UNESCO, pp.133-142

II One of the ancient and still unconquered illnesses of the tropics and subtropics of Africa, Asia and the Americas is bilharzia or schistosomiasis. Modern technological advances have failed to provide a remedy for the infection, the source of enormous social and economic problems in many Developing Countries. This article describes how a simple natural product has been used to control the disease on a self-help basis.

Levy-Lambert, E., Manual of Basic Techniques for a Health Laboratory, Geneva, WHO, 1980

III A revised edition of the manual published by the WHO in 1973. It is intended as a teaching aid for health laboratory workers and students who will work in rural hospitals and health centres. The book is well illustrated and presents simple instructions on the techniques; and it is organised in three parts. Part I deals with basic laboratory practices and equipment; Part II with parasitology and bacteriology; and Part II with urinalysis, analysis of cerebro-spinal fluid, and with haematology.

Melrose, D., Bitter Pills: Medicines and the Third World Poor, OXFAM, 1982

II Based on extensive field research, case studies and dialogue with pharmaceutical manufacturers and international agencies, this book examines the background to illness in Developing Countries and the obstacles to good health and better control of drug promotion and sales. Traditional medicine, successful schemes for appropriate medicine and national and regional policies are discussed as some of the positive actions being taken as part of broader strategies to rationalise the use of drugs in the pursuit of better health.

Morley, D. & Woodland, M., See How They Grow, Macmillan Tropical Community Manuals, 1979, £1.50

II Intended for health workers and teachers in Developing Countries, and sold at a low price with a subsidy from the Catholic Fund for Overseas Development. This book describes and explains the use of the Marley weight chart as a simple and cheap tool to assess child health and nutrition. It enables families and health workers to detect early signs of malnutrition. The book also contains practical suggestions for the control of illnesses which might damage child development, and it details ideas for useful ways of promoting child health.

Norton, A., Drugs, Science and Society: The New Dimensions of Medicine, Collins/-Fontana, 1973

II The introduction of new drugs, advances in surgery, the development of psychiatry, the spread of preventative medicine, the sophisticated use of statistics and computers - these and other advances have revolutionised medical care in Western societies. Writing as a professional for the lay person, the author discusses the underlying moral, social, economic and political questions and their implications.

Read, M., Culture, Health and Disease: Social and Cultural Influences on Health Programmes in Developing Countries, Tavistock, 1966

III Part I of this book covers the essential background for understanding people's reactions to modern health programmes. Parts II and III present studies of traditional self-help systems of health care in Developing Countries. The recognition of the dual process of social change and social continuity in relation to people's ambivalent response to health programmes is emphasised as an essential in the training of rural health personnel.

von Wartensleben, A., 'Major Issues Concerning Pharmaceutical Policies in the Third World' in Pharmaceuticals and Health in the Third World, special issue of World Development, Vol. 11, No.3, 1983, Pergamon, pp.169-175

III Introducing this issue, the author discusses the requirements for the supply, selection and distribution of drugs in the Developing Countries. She also discusses the crucial technologies relevant to the pharmaceutical industry and their transfer and development.

Webster, C. (ed.), Biology, Medicine and Society 1840-1940, Cambridge University Press, 1981

II Notwithstanding the great fall in the crude death rate in Britain before 1940, it was felt that advances in nutritional science, medicine, sanitation, hygiene and housing had failed to bring proportional benefits to the mass of the population. Through a historical study of Britain, the essays comprising this volume explore the major relationships of biology and medicine to politics and policy. They demonstrate that despite the apparent isolation, sophistication and objectivity of modern science, the cross currents between biological and social thought persist.

Weir, D. & Schapiro, M., Circle of Poison: Pesticides and People in a Hungry World, Institute for Food and Development Policy, San Francisco, 1981

II The authors describe and document the dumping on Developing Countries of pesticides which are considered too hazardous for unrestricted use in the United States. They review the sale, distribution and use of those pesticides, and their toxic effects. The 'Circle' of the title is completed by the presence of residues of those same pesticides in foods imported into the U.S.A. from Developing Countries. The study concludes with proposals for overcoming the problems described.

World Health Organization, Reference Material for Health Auxiliaries and Their Teachers, REMAHA, World Health Organization, 1211, Geneva 27, Switzerland

III An annotated bibliography, free from the WHO. It is intended to be suitable for teachers and students, and to help groups establish their own local set of reference materials appropriate to their local needs and concerns.

APEID (Asian Programme of Educational Innovation for Development), Linking Science Education to the Rural Environment: Some Experiences, UNESCO, Bangkok, 1980

III Reports on experiences and projects of several countries in the region (Asia and Pacific) on attempts to link science education to the rural environment.

Balon, E.K., 'Kariba: The Dubious Benefits of Large Dams', Ambio, Vol.VII, No.2, 1978, P.O.Box 7508, Skillebekk, Oslo 2, Norway, pp.40-48

II The building of this huge dam on the Zambesi was accompanied by the destruction of the ecological balance of the entire region. Electricity was produced in order to export profitable mineral resources, rendering the local population dependent on outside sources of subsistence. The surface of the lake reflects more solar energy than the terrestrial system, and as a consequence fish production is lower than the lost production of plants and game. A once self-sufficient region is now dependent on outside help to survive.

Bernard, Jnr., H.W., The Greenhouse Effect, Ballinger Publishing Co., Cambridge, Massachusetts, 1980

II A critical review about the scientific and ecological controversy concerning the impact of accumulations of carbon dioxide in the upper atmosphere. The carbon dioxide is, in large part, a product of the combustion of fossil fuels in industry. This book seeks to establish the extent and limitations of scientific knowledge on this crucial ecological factor. The author argues that much of the work on the Greenhouse effect remains speculative, and we do not get to know precisely how much damage carbon dioxide is doing or could do. Nonetheless, he concludes that the balance of evidence indicates that the most sound policy would be to lessen our reliance on fossil fuels as the primary source of energy.

Bowonder, B., 'Environmental Risk Assessment Issues in the Third World', Technological forecasting and social change, Vol.19, No.1, 1981, Elsevier, New York, pp.99-127

II This article analyses environmental risk assessment issues in Developing Countries and provides some examples of major environmental risks. The prevalent low literacy level, the absence of mass media oriented towards environmental issues, poor public awareness, the weak environmental movement and the lack of institutionalised environmental concern are identified as the major constraints on a proper risk assessment system.

Braun, E. & Collingridge, D., Technology and Survival, Butterworths, for SISCON, 1977

II A classroom text designed to provide a comprehensive introduction to issues concerning science, technology and environmental problems. It is organised into seven sections as: Exhaustion of Natural Resources, Pollution, Population, Limits to Growth, The Technological Fix, Intermediate Technology and The Blueprint for Survival. In a slim volume, the authors manage to present much quantitative data, with challenging questions, and a valuable bibliography.

Bull, D., A Growing Problem: Pesticides and The Third World, Oxfam, 1982, £4.95

II A critical and constructive look at the use of pesticides in Developing Countries. Pesticides promise higher crop yields, but they may also be hazardous to the rural population. This book examines the technical and social consequences of the use of pesticides and estimates both costs and benefits, and describes their distribution. It also contains suggestions on how to make the best use of pesticides, while minimising hazards to the local population. It concludes with some policy proposals for governments, industry and international organizations.

Clapham, W.B., 'Environmental Problems, Development and Agricultural Production Systems', reprinted in Environmental Conservation, Vol.7, No.2, Summer 1980, Elsevier Sequoia S.A., P.O. Box 851, 1001 Lausanne, Switzerland, pp.145-52

II It makes no sense to appeal to the long-term economic rationality of ecologically stable agricultural production if a farmer is so concerned with having enough to eat that his plans extend no further than the next harvest. The significance of environmental problems reaches far beyond ecological phenomena. Any practical analysis of the agricultural environment must recognize the cultural, economic and policy nature of the problems as well as their ecological base. The solutions also are apt to be culturally determined.

Cole, H.S.D. et.al., "The Limits to Growth", Chatto and Windus, 1973

II One of the central contributions to the debate about the Club of Rome's book on the Limits to Growth. Organised in two sections the book deals firstly with the several sub-systems of the Limits to Growth computerised model, exploring the technical details of that model; and secondly exploring the ideological presuppositions of the model and its use for extrapolations into the future.

Croall, S. & Rankin, W., Ecology for Beginners, Writers and Readers, 1982

II Wittily documented and illustrated, this book translates the most complicated information into a simple and readable introduction to international ecological issues.

Dasmann, R.F. et.al., Ecological Principles for Economic Development, John Wiley and Sons, 1973

II The authors explore the interrelationships between development and conservation and demonstrate that both must be based on an understanding of ecology. Particular emphasis is placed on ecosystems which are currently subject to heavy developmental pressures: tropical humid forests, savannas and grasslands in tropical, sub-tropical and Mediterranean regions. Various contemporary problems arising from irrigation and river basin development, forestry, livestock and agricultural projects are all reviewed.

Diament, B.Z., 'Environmental Repercussions of Irrigation Development in Hot Climates', reprinted in Environmental Conservation Vol.7, No.1, Spring 1980, Elsevier Sequoia S.A., P.O.Box 851, 1001 Lausanne, Switzerland, pp.53-58

II In the development of modern irrigation programmes during the second half of the century the environmental aspects have too often been overlooked. This has resulted in a severe spread of water-borne diseases among people living in the areas so developed. The author argues that the operation and maintenance of such schemes should include regular surveillance by ecologists, environmental engineers, entomologists and medics. People will also need to be prepared for the changes in their lives and habits caused by irrigation development.

Eckholm, E.P., Losing Ground: Environmental Stress and World Food Prospects, Pergamon Press, Oxford and New York, for Worldwatch Institute, with the United Nations Environment Program, 19878

II This work surveys and analyses the various ways in which our delicately balanced food systems are being ecologically undermined. It provides concrete examples of the serious ecological deterioration that is taking place through deforestation, overgrazing, soil erosion and abandonment, desertification, the silting of irrigation systems and resevoirs, and the changes in the frequency and severity of flooding. In all of these, the increasing intensity of humanity's pressure on the land and the continuation of careless and short-sighted land use practices compound the effect of natural phenomena such as droughts, often turning the temporary problem into a large-scale disaster.

Favar, T.M. & Milton, J.P. (eds.), The Careless Technology: Ecology and International Development, Natural History Press, New York, 1973

II This conference was designed to investigate the question: "To what extent have the ecological costs of introducing technology affected the less-developed countries?" The profound scientific, social and ethical issues surrounding health and nutrition programmes, irrigation and water development, plant and animal productivity and specific hazards of environmental degradation are discussed at length in this large (pp.1030) and comprehensive volume.

Foley, G. et.al., The Energy Questions, Penguin 1981

II A comprehensive survey of energy in the modern industrial world, at an aggregate level. The first part reviews general issues of energy ecology for human beings, and the second part reviews the major potential or actual sources of energy including: coal, petroleum and oil, nuclear power, non-depleting sources and energy conversion processes. The final section considers future plans and possibilities. One major limitation of this useful text is that it does not pay specific attention to the energy needs of Developing Countries.

Frank, R.W. & Chasin, B.H., Seeds of Famine: Ecological Destruction and the Development Dilemma in the West African Sahel, Allanheld, Osmun & Co. Publishers, Montclair, New Jersey, & Universe Books, New York, 1980

III An attempt to provide a systematic examination of the relations between a crisis of food supplies and a crisis of ecology. The authors describe the drought and the famines in the Sahel region in the 1970's. They argue not that drought has caused famines, but that both drought and famines have to be explained in terms of social and economic forces and processes in the region. They argue, moreover, that the events in the Sahel exemplify what may be in store for other regions.

Freeman, C. & Jahoda, M. (eds.), World Futures: The Great Debate, Martin Robertson, 1979

II A collection of nine papers, plus an introduction and a conclusion, by members of the Science Policy Research Unit of the University of Sussex, reviewing some ten years of debate about the value and predictions of a range of computer models of global development. The authors collectively seek to contribute to the methodology of forecasting, to consider whether a desirbale future is attainable within fifty years or so, and to propose policies which may contribute to the attainment of such goals.

Fuller, J. G., The Poison That Fell From The Sky, Berkeley Publishing Corporation, New York, 1979

II A powerful account of the accidental poisoning of the Italian town of Seveso by the chemical Dioxin. It describes the initial accident, the subsequent contamination and the consequences for the local inhabitants. It also reviews the role and responsibilities of the company concerned and the local and national administrations.

Gorz, A., Ecology as Politics, South End Press, Boston, Massachusetts, 1980

II A challenging, but rewarding, attempt to treat ecological problems not simply as technological problems for which there can be technocratic solutions, but as social problems for which social changes are required for their solution. This book deals with many of the issues which are the subjects of this bibliography, for it has much to say on the nature of education and work, and the social impact of scientific and technological changes. The final section in particular deals with 'Medicine, Health and Society'.

Guggenheim, H. & Fanale, R., 'Shared Technology: A Project for Water Storage and Irrigation in Dogen Villages', African Environment Occasional Paper No.76-1, 1976, ENDA, P.O. Box 3370, Dakar, Senegal, pp.16

II Just as traditional technological responses set limits to the benefits people can derive from their environment, so do modern technological solutions create hazards and new problems that emerge as the boundaries of traditional productivity are broken. It is essential for technicians to approach problems as part of a joint effort with the people with whom they are working. The details of a project are described in order to show how development decisions involve the outsider as well as the local population in difficult choices regarding priorities, choices defined by the social and physical environment.

Haggis, S.M. & Adey, P., 'A Review of Integrated Science Education Worldwide', Studies in Science Education, Vol. 6, 1979, pp.69-89

III Discussion of trends in integrated science education which includes a trend towards social relevance in teaching of integrated science through environmental issues.

Hayes, D., Rays of Hope, The Transition to a Post-Petroleum World, W.W. Norton & Co. Inc., New York, 1977, for the Worldwatch Institute

II This book argues that it is necessary that we do not depend on fossil fuels or on nuclear power, but that we should come to rely increasingly on re-newable energy sources which derive directly or indirectly from solar power. The author examines alternative energy sources in detail and explores their likely effects on employment, diets and lifestyles.

Hosier, R., et.al., 'Energy Planning in Developing Countries: Blunt Axe in a Forest of Problems?', Ambio, Vol. X1, No.4, 1982, P.O. Box 7508, Skillebekk, Oslo 2, Norway, pp.180-87

II Energy planning in Developing Countries must be rethought in the context of a more general crisis of development planning. An alternative approach is suggested featuring biomass and commercial fossil fuels as twin pillars of a strategy that takes full account of the political and ecological character of rural economies.

Mabey, R., The Pollution Handbook, Penguin, 1974

II Concentrating on air and water pollution, the book describes how pollution is created and can be easily measured by anyone of us. Practical instructions.

Mann, H. & Williamson, D., Water Treatment and Sanitation: Simple Methods for Rural Areas, Intermediate Technology Development Group, 1973

II This is intended as a practical handbook on the provision of a water supply and sewage disposal systems for small communities at low cost. It is not an engineering textbook but it is meant for technicians, including school adminstrators and teachers. It includes information of the selection of water sources, simple water testing, treatment and sewage disposal, dealing both with methods and equipment.

McCutcheon, R., Limits of a Modern World: A Study of the "Limits to Growth" Debate, Butterworths, for SISCON

II A classroom text providing a review of the debates on Meadows et.al. The Limits to Growth (q.v.). It reviews the background to the Club of Rome's project, and critically examines the main areas of debate, namely: population, food, non-renewable resources and pollution. It concludes with a critical study of the assumptions and methods of Meadows et.al.

Meadows, D.H. & Meadows, D.L. et. al., The Limits to Growth, Pan Books, London, 1972

II A report from the Club of Rome attempt to provide quantitative computer models of the future of the human world. Their results were on the whole very pessimistic, even with the assumption of a stabilised human population. The work has subsequently been the focus of much controversy and some criticism. Much of these debates has focussed on the adequacy of many of the assumptions built into the computer model.

Mhlanga, L., 'The Impact of Technology on the African Environment', African Environment Occasional Paper No.76-7, Environment Training Programme, P.O. Box 3370, Dakar, Senegal, 1976, pp.29

II This paper views the impact of technology on the African environment as arising from Africa's historical association with the Western world and its physical characteristics and poverty which contribute to environmental problems. Case studies are described and some problems and possible solutions presented.

National Academy of Sciences, Energy for Rural Development: Renewable Resources and Alternative Technologies of Developing Countries, 1976, available free from: Commission on International Relations, National Academy of Sciences. 2101 Constitution Ave. NW, Washington D.C., 20418 USA

II A review and summary of tested and manufactured technologies considered appropriate to rural and small-scale energy needs in Developing Countries. It covers a wide range of energy sources and storage. The products listed are assessed both technically and economically .

Ophals, W., Ecology and the Politics of Scarcity, W.H. Freeman and Co., 660 Market Street, San Francisco, USA, 1977

II Starting from a thorough review of the arguments for the development of, and increasing reliance upon environmentally-sound appropriate technologies, the author proceeds to examine the political conditions for the attainment of an ecologically sustainable modernised economy. He argues that it is the Developing Countries which are best placed to move in the desired direction. Informing the whole discussion is a desire to establish and enforce democratic social institutions for the author fears that ecological pressures could contribute to the entrenchment of tyrannical totalitarian regimes.

Passmore, J., Man's Responsibility for Nature, Duckworth, London, 1974

II A work based on historical and philosophical scholarship addressed to central issues of human ecology which is clear and accessible to the non-expert reader. In Part One the author critically describes two traditions regarding man's relations with nature, namely 'Man as Despot', and 'Stewardship and Co-operation with Nature'. He then considers in turn the debates concerning pollution, conservation, preservation and population. The final chapter is an exploration of the conflicts between Western traditions and ecological problems. It assesses what the West has to jettison and what to retain if it has any prospect of solving ecological problems, and this chapter is also intended as a warning to Developing Countries as they seek to industrialize.

Pedler, K., The Quest for Gaia: A Book of Changes, Granada Publishing, London, 1981

II A very accessible and enthusiastic discussion of a whole set of practical proposals for a more ecologically viable form of life. The book is intended to inspire and encourage optimism and practical innovations, as well as to provide useful ideas which people can incorporate into their daily lives.

Sandbach, F., Environment, Ideology and Policy, Basil Blackwell, Oxford, 1980

II Many of the views expressed in the environmental debate appear, at least superficially, to be based on firm scientific evidence, but a closer look shows them to be steeped in ideology. This book is an excellent attempt to provide an understanding of environmental problems in terms of the social, economic and political organisation of the societies in which they arise. Consideration is given to both Developing and Industrialised Countries and the underlying themes of the book are illustrated by a discussion of Chinese technological and environmental policy in relation to economic development.

Shiva, V. et. al., Social, Economic and Ecological Impact of Social Forestry in Kolar, Indian Institute of Management, Bangalore-560027, India, 1981, pp.83

III It is observed in this study that the social forestry in Kolar district as presently practised lacks the organisational and economic requisites for the satisfaction of the basic needs of the forest people. In the process of aforestation a substantial amount of forest cover has emerged at the cost of foodcrop cultivation. The social and economic consequences for the landless labourers and marginal farmers are discussed along with the environmental impact of the programme.

Simmons, I., The Ecology of Natural Resources, 2nd Edition, Edward Arnold, 1981

II An introduction to a coherent system of evaluation and management of Earth's resources, with clear recognition that human adjustments must be made through the media of human culture. Interaction of natural and social systems. With a bibliography.

Soauma, E., 'Promoting the Rational Use of Living Resources', reprinted in Environmental Conservation, Vol.7, no.2, Summer 1980, Elsevier Sequoia S.A., P.O. Box 851, 1001 Lausaznne, Switzerland, pp.93-97

II This article briefly summarises the ecological, economic, social, cultural and political constraints which need to be exercised on agricultural productivity in Industrialised and Developing Countries.

United Nations Environment Programme, Environment and Development in Africa, Pergamon, 1981

III This intriguing study is a tentative effort to forecast the likely outcome of various development strategies in Africa: (i) dependent growth and environmental misuse; (ii) greater economic autonomy and attention of environmental issues; (iii) environmental development. The social, economic, political and technological aspects of the three scenarios are discussed and their final outcomes projected.

Villavicencio, R. R., Adapting Science and Technology Education to the Local Environment, a report prepared for a UNESCO meeting on Adapting Science and Technology Education to Changing Societies and to the Diversity of Needs of Member States, July 1980

III This is a description of a project in the Philippines aimed at adapting science and technology to the local ecological setting and real life situations. (Integrated Rural Development Through Science Education.)

APPENDIX

List of Publishers

Allen (George) & Unwin Publishers Ltd., Rusking House, 40 Museum Street, London WCIA ILU, U.K.

Allison & Busby Ltd., 6A Noel Street, London, WIV 3RB, U.K.

American Association for the Advancement of Science (AAAS), 1515 Massachusetts Ave., NW, Washington, DC 20005, U.S.A.

Anchor Doubleday, 277 Park Ave, New York 10017, U.S.A.

Arnold (Edward) Ltd., 41142 Bedford Square, London WCIB 3DQ, U.K.

Ballinger Publishing Corp., 17 Dunster Street, Harvard Square, Cambridge, Mass. 02138, U.S.A.

Basic Books Inc., 10E 53rd Street, New York, NY 10022, U.S.A.

Baywood Publishing Co., 120 Marine Street, P.O. Box D, Farmingale, New York 11735, U.S.A.

Beacon Press, 25 Beacon Street, Boston, Mass. 02108, U.S.A.

Berkley Publishing Corp., 200 Madison Ave., New York, NY 10016, U.S.A.

Blackwell (Basil) Publisher Ltd., 108 Cowley Road, Oxford, OX4 IJF, U.K.

Blond & Briggs Ltd., Dataday House, 8 Alexandra Road, London SW19 7JZ, U.K.

Boyars, Marion, Publishers Ltd., 18 Brewer Street, London WLR 4AS, U.K.

Burgess Publishing Co., 14 John Street, London WCIN 2EJ, U.K.

Butterworths, 88 Kingsway, London WC2B 6AB, U.K.

Cambridge University Press, The Edinburgh Building, Shaftesbury Road, Cambridge, CB2 2RU, U.K.

Canadian Hunger Foundation, 75 Sparks Stree, Ottawa, Ontario KIP 5A5, Canada

Cape (Jonathan) Ltd., 30 Bedford Square, London WCIB 3EL, U.K.

Cass (Frank) & Co. Ltd., Gainsborough House, 11 Gainsborough Road, London E11 1RS, U.K.

CBS Educational & Professional Publishing, 383 Madison Avenue, New York, N.Y. 10017, U.S.A.

Chatto & Windus Ltd., 40 William IV Street, London WC2N 4DF, U.K.

Churchill Livingstone, Robert Stevenson House, 1-3 Baxter's Place, Leith Walk, Edinburgh EH1 3AF, U.K.

Clarendon Press - see Oxford University Press

Collier Macmillan Ltd., Stockley Close, Stockley Road, West Drayton, Middlesex, UB7 9BE, U.K.

Collier Macmillan International, 866 Third Avenue, New York, N.Y. 10022-6299, U.S.A.

Collins (William) Sons & Co. Ltd., 8 Grafton Street, London W1X 3LA, U.K.

Columbia University Press, 562 West 113th Street, New York, N.Y. 10025, U.S.A.

Cornell University Press, 124 Roberts Place, Ithaca, New York, 14851, U.S.A.

Croom Helm Ltd., Provident House, Burrell Row, Beckenham, Kent BR3 1AT, U.K.

Council for Science and Technology in Developing Countries (COSTED), International Council of Scientific Unions, 51 Blvd de Montmorency, F-75016, Paris, France.

Council of Scientific and Industrial Research (CSIR), Rafi Marg, New Delhi, India.

David & Charles (Publishers) Ltd., Brunel House, Forde Road, Newton Abbot, Devon TQ12 4PU, U.K.

Dodd, Mead & Co. Inc., 245 Park Avenue, New York, 10167, U.S.A.

Dorsey Press Inc., 1818 Ridge Road, Homewood, Illinois 60430, U.S.A.

Duckworth (Gerald) & Co. Ltd., The Old Piano Factory, 43 Gloucester Crescent, London NW1 7DY, U.K.

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